Chapter 8 Cascade System Development Plan and Proposed Projects

8.1 Overall Cascade System Development Plan

8.1.1 General

Based on the development concept proposed in Chapter 5; and results of the detailed survey and field verification programmes described in Chapters 6 and 7, respectively, the cascade system development plan including infrastructure development plan, institutional development plan, agriculture development plan, post harvest and marketing development plan, livestock development plan are proposed aiming at increment of the income and livelihood of farmers. The cascade system development plan is the part of the North Central Province Canal Project prepared based on the feasibility study report of April 2016 carried out by Mahaweli Consultancy Bureau under MMDE. The target area is 128 cascade systems with 31,446 ha of irrigable area

Totally 15 necessary actions as a project under five development plan are proposed with the total cost of LKR.36,819 million. The farmers income from irrigated and non irrigated agriculture and cattle farming will increase from LKR.151,000 to LKR.587,000 per household with implementation of 15 projects. Those projects are proposed to implement for ten years before and after completion of the North Central Province Canal Project (NCPCP).

As described in Chapter 5, the firm infrastructure to support for intensive agriculture and fare and timely water distribution system of NCPC water for crop diversification with proper maintenance by empowering the farmers are needed. The infrastructure development plan focused on those aspects and proposes two projects. The institutional development plan focuses on establishment of cascade management organisation with proper legal support. The plan also support establishment and enhancement of main and branch canal operation bodies and proposes four projects.

The realisation of profitable agriculture requires more labour and capital and the farmers have limited knowledge of irrigated agriculture for other field crop. Those are the constraints for farmer to boost crop diversification. The agriculture development plan focuses on mechanisation, cultivation skills development and credit support. In addition, the coverage of extension officer is large and it is required to improve the mobility of officer, communication and information management system and technologies transferring system in the area. The agriculture development plan includes those aspects.

The post harvest and marketing development focuses on necessary actions to assure the market channel of the production which will be increase due to the augmentation of the water and crop diversification. The marketing plan proposes direct marketing system between farmers and high end consumers and promote contract farming with agribusiness partners. The livestock development plan focuses on the aspect of feed production and delivery with breeding improvement since the grazing yard is limited especially in Yala due to the crop production after arrival of NCPC water to the area.

In this Chapter, the details of the cascade system development plan and outline of the proposed projects are described. The concept notes of each project are summarised in the Attachment 5.

8.1.2 Agriculture Production Plan for Profitable Agriculture

As described in Chapter 5, the concept of profitable agriculture is advanced based on the presumption that the farmers' net income level should equal or exceed that of middle level wage earners at the national level. It is contemplated that the income increment may lead to the emergence of cascade agriculture as a profitable professional enterprise that ensures the economic viability, enhances welfare of household members and boosts up farmers esteem. The agricultural development plan for profitable agriculture is prepared based on the key development aspects after analysing the results of detailed surveys and verification programs carried out in the six model cascades.

(1) Key Aspects in Preparation of Agricultural Production Plan

(a) Land Suitability

Located in Anuradhapura and Vavuniya districts in the north central region of Sri Lanka, the agro-ecology of the target area is described under the agro-ecological sub-regions of DL 1b and DL 1e of which the rainfall and soils play significant roles in determining crop performance.

The average annual rainfall, mean temperature, and humidity are < 1,500 mm, 30 °C, and 80%, respectively. The northeast (NE) monsoon is the main source of rainfall which lasts from late October/early November to late December/early January (*Maha* season). Rainfall in the pre-NE monsoonal and monsoonal period accounts for about 70% of the total rainfall, which is concentrated in a period of less than four months. The southwest monsoon period from May to August (*Yala* Season) is relatively dry and the seasonality of rainfall is well marked with 3 to 4 months of drought common in normal years.

Medium density soil investigation covering the command area of the six selected model cascades was conducted to identify, classify, and map soils occurring in the survey area. The results of the survey revealed that 64% of the survey area comprised poorly drained lands occurring in lower valley bottoms followed by 32% imperfectly drained, and 4% moderately well drained/well drained lands in the bordering upper slopes in the catena.

Considering the land and soil suitability to the crops, the project applies the following criteria shown in Table 8.1.1to select the proposed crop for agriculture production planning.

Table 8.1.1 Applicability of the Crop by Soil Drainage Type

Crop	Well Drained		Imperfectly Drained		Poorly Drained	
	Maha	Yala	Maha	Yala	Maha	Yala
Paddy	-	-	*	-	*	*
Chilli	*	*	-	*	-	-
B-onion	-	*	-	*	-	*1
Grain legumes	*	*	*1	*	-	*1
Coarse grains	*	*	-	*	-	-
Vegetable	*1	*	*1	*	*1	*1

*Note: * :applicable *1 :applicable with deep drain -:not applicable*
Source: JICA Project Team

(b) Labour Requirement

Only 65% of the household heads worked fulltime in their farms whilst 28% worked part-time, with the remainder not engaged in farm labour work. The labour availability at the household level is augmented by the contribution made by other members in the household on full or part-time basis. The average availability of farm labour per household is estimated at less than 2 units. Household labour is deployed for crop production in the irrigated lands as well as in the highlands and home-gardens. Over 42% of households in the survey reported of labour shortage under the present farming conditions. Around 88% of the households are dependent on hired labour at peak demand periods whilst the balance totally depended on hired labour for farm work. With the anticipated increase in the cropping intensities and associated diversification into labour intensive high-value crops, the demand for hired labour in the target area is likely to increase significantly. The need to complete specific tasks within the set time periods resulting in peaks in labour demand would further aggravate the situation. In addition, 33% of the respondents found the present daily wage rate of LKR 1,300+ too high. Scarcity of hired labour for farm work is foreseen as a major issue that will confront in the implementation of a crop diversification program.

Considering the gradual advancement to labour saving farm mechanisation, proposed as a development concept in Chapter 5, the project applies the labour requirement of 150 man-days/ha/season in the preparation of the production plan.

(c) Capital Requirement for Farming

The detailed survey revealed that 73% of the households used their own funds for cultivation. The situation is comprehensible in view of the small size of farm holdings, low investment cost needed for paddy cultivation (average of LKR 116,000 per ha) and the contribution from off-farm income (average of 33% households). Only 4% of the farmers depended fully on cultivation loans obtained from formal lending agencies whilst 17% used credit from their own bank sources for cultivation. Cultivation of high-value crops is capital intensive and unlike paddy cultivation, it necessitates funding from outside sources. Information on creditworthiness of individual farmers due to bank defaults is not available.

The project applies the capital investment requirement level for farming as LKR 250,000 /ha/season in the preparation of production plan.

(d) Farmers' Production Technology and Intention

Nearly 95% of the farmers who were willing to diversify their irrigable lands preferred maize and pulses (green gram and black gram) as their alternate crops for cultivation in the *Yala* season. Only 5% preferred vegetables. Around 55% of the respondents in the survey identified general areas of crop production and plant protection as their training needs but failed to specify topics under the subjects. This may well be attributed to the lack of awareness, lack of previous experience or both amongst the farmers on other potential high-value crops available for their consideration. Furthermore, farmers lacked experience in cultivating ordinal Other Field Crops (OFCs) and high-value vegetables under irrigation in the tank command area. The situation reflects the need for intensive crop specific agricultural information and technology transfer system for promotion of ordinal and high-value crops amongst farmers. The main areas for capacity development of farmers can be grouped under general OFCs and vegetables. The general aspects would consist of crop selection based on available resources, crop agronomy, water management for irrigation and drainage, crop calendar and lastly, environmental issues. Likewise, under the OFC category, nursery management of condiments and under vegetables, organic farming, GAP registration and postharvest handling are considered necessary.

About 14% and 65% of the farmers were willing to consider crop diversification in their irrigable lands, either totally or partially in *Maha* and *Yala* seasons, respectively. Majority of them (60%) cited the higher net incomes that could be realised from non-paddy crops. Amongst those who were reluctant to diversify, 80% thought that the soil in their farmland is not suitable to grow non-paddy crops whilst 10% found their land holding were too small to take up diversification. The general inclination of farmers towards crop diversification was positive in the backdrop of a highly traditional paddy centric cropping system practiced in the target area.

Demonstration and training of farmers on cultivation of selected high-value vegetables, carried out in collaboration with CIC Seeds (Private) Ltd. at their Dambulla and Talawa seed farms, proved to be a success with the participants who were well impressed by the performance of the exotic vegetables, cabbage, cauliflower, beetroot, and coarse grain sweetcorn. They expressed interest in testing the vegetables in their own irrigated lands. Thus, it is concluded that farmer willingness is not a deterrent in promoting crop diversification.

(e) Demand in the Market and Country

In years of normal rainfall distribution, the target area of the National Cleaner Production Centre (NCPC) makes a contribution of nearly 3.0% to the total production of 4.82 million tons (2015) of paddy in the country, thereby supporting the national goal of sustaining self-sufficiency. Maintaining the present contribution to the national requirement of paddy from the target area with a provision of an annual increase of at least 1.1% to meet the future demand has been taken into consideration. As mentioned in Chapter 7, six traditional rice varieties, namely; Swandel, Kuruluthuda, Pacchaperumal, Heenati, and Madathwalu, show growing market demands. Other crops in the high-value group such as vegetables (cabbage, cauliflower, bell pepper, sweet corn and broccoli), fruits (watermelon and cantaloupe melon) and condiments (chilli and big onion) also have a high market demand. In addition, the national requirements of maize, soybean, and condiments are met through imports. The present demand situation of the crops was taken into consideration in preparation of the production plan.

(2) Selection of Crops

The potential crops selected basically consist of ordinal crops and high-value vegetables. The main criteria applied in the process are the crop water requirement, labour requirement, cost of production, and the net return per unit land area. Respective values per type of crop are shown in Table 8.1.2.

Table 8.1.2 Summary of Crop Characteristics under Important Aspects

Crop	Crop Water Requirement (mm/crop)	Labour Requirement (man-days/ha)	Cost of Production (LKR/ha)	Gross Return (LKR/ha)	Net Return (LKR/ha)
Paddy	1,500	52.5	116,763	218,500	101,737
Paddy (Traditional)	1.500	50.0	105,557	246,000	140,443
Paddy (New Improved)	1,500	52.5	116,763	270,000	153,237
Green Gram	350	117.5	158,805	240,000	81,305
Black Gram	360	75.0	115,260	220,000	104,740
Soybean	380	130.0	178,000	300,000	122,000
Groundnut	390	132.5	185,543	422,500	236,957
Chilli (Green)	500	262.5	354,988	876,250	521,262
Big Onion	420	447.5	678,093	1,800,000	1,121,907
Maize	390	80.0	138,968	227,500	88,532
Cabbage	350	342.5	524,845	1,200,000	675,155
Beetroot	295	305.0	531,970	1,050,000	518,030

Source: JICA Project Team

(a) Paddy

Poorly drained Lower Humid Grey (LHG) soil that dominate the command area of the tanks, the monsoonal weather pattern experienced in the area as well as the farmers' traditional affinity towards favouring paddy based cropping systems, all contribute to the farmers decision to focus on paddy cultivation. Furthermore, farmers are attracted by the government incentives granted for paddy production.

However, the extension of paddy fields, particularly in the *Yala* season after receiving NCPC water, has number of limitations. First, the crop water requirement of paddies is the highest with a consumptive use of 1,500 mm compared with most of the OFCs and vegetable crops that rarely exceed 500 mm. Thus, the land area available for cropping would severely be reduced if cultivated with paddy and the increase in the cropping intensity would be only marginal. Furthermore, the net return from the cultivation of paddies is lower than what can be earned from growing most other seasonal crops. All of these factors considered, the potential of the land and the farm profitability realised by growing paddies would be nominal at best.

Complying with the national need for food security and the agricultural tradition in the area, paddies will remain a dominant crop in the targeted area. Under these circumstances, enhancement of farm income by paddy cultivation was contemplated through increased productivity and vertical diversification. In order to ensure enhanced farm income, increase in the paddy productivity is anticipated. The average productivity of the irrigated land in the project area, measured at 4.1 t/ha, is far below that of 6.5 t/ha recorded in major irrigation schemes in the district. With the assured water supply and the anticipated improvement in crop management supported by strengthened extension services, it is expected that the average paddy yield in the project area would reach 5.75 t/ha. Vertical crop diversification by incorporating high-value traditional paddy varieties and newly released varieties from the Rice Research and Development Institute (RR&DI) having special attributes are recommended. The special attributes possessed by these varieties enjoy a high consumer appeal, higher market prices, as well as an opportunity for possible regional specialisation for branding and gainful market penetration.

(b) Coarse Grains

Maize is the next most important coarse grain produced in the target area and its cultivation is restricted to highlands as a rain-fed crop in the *Maha* season. Although the profitability is below that of paddy, maize is recommended for inclusion in the cropping pattern as an irrigated *Yala* crop. This is in consideration of the low crop water requirement, enabling increased cropping intensity, large national requirement to bridge the demand, farmer preference due to crop familiarity and the active engagement of private sector operators for extension and produce marketing. Sweetcorn, although not cultivated in

the target area, is considered a potential crop just like the green cobs which both sell at a relatively high price compared with that of maize cobs, which in turn, drive an increasing demand in the market. Its cultivation was successfully demonstrated to farmers at the verification stage of the project and is included along with maize.

(c) Grain Legumes

Black gram, green gram, and cowpea are the main grain legumes cultivated in the highlands as rain-fed *Maha* crops. Although the net returns are low being in the same range as that of paddy, they possess high nutritive value and are a principle source of cheap protein in the Sri Lankan diet. Low crop water requirement, farmer preference, and ease of marketing are the main attributes for recommending the grain legumes in the cropping pattern.

The national requirement of soybeans, included in the subcategory of oil seeds, is high in order to bridge the wide gap between local production and imports. Although income from growing soybean is only marginally higher than that of paddies, future market demand and price is expected to stabilise.

(d) Condiments

The main condiments considered for inclusion are chilli and big onions. Both are high-value crops that generate substantial profits much higher than that of other crops. The current total production in the country is less than one half of the national requirement and tends to increase in the future. Many farmers in the target area have been growing these crops in their home gardens and highlands in rain-fed conditions and lift irrigation in the *Maha* and *Yala* seasons, respectively.

(e) Vegetables

Vegetables are generally high profit crops and are grouped under the category of high-value vegetables. Cultivation of local vegetables is common amongst farmers and the crops are grown almost exclusively in their home gardens. In an effort to create awareness and interest amongst farmers, demonstrations and training on selected high-value vegetables were carried out in collaboration with CIC Seeds (Pvt) Ltd. at their Dambulla and Talawa farms. Farmers who participated in the program were highly impressed by the performance of the exotic vegetables such as cabbage, cauliflower, and beetroot, which are relatively new to the area. The farmers even expressed interest in testing them in their own irrigated lands. Vegetables are an important crop group and therefore are considered for inclusion in the cropping plan.

(3) Production Plan

The project applies a cropping intensity of 180%, 95% in the Maha season and 85% in the Yala season for planning. Proposed production plans are formulated by applying a trial and error approach for the six model cascade systems with due attention to aspects such as land and soil suitability, labour requirement, capital requirement, farmers' technology and intention, market and national demand, as well as, the water balance study carried out with CASCADE VBA model developed by the Japan International Research Centre for Agricultural Services (JIRCAS) with using 75% probability rainfall as described in Chapter 6. The proposed production plans for the six model cascades and the result of the water balance study are shown in the Annex 4, and combined production plan is shown in Table 8.1.3 hereinafter.

Table 8.1.3 Proposed Production Plan for the Six Model Cascade Systems for the Irrigated Area

Crop	Cultivation Area (ha)								Net Income		Required Labour (days)	Required Capital (LKR Mil)
	Maha				Yala				Maha (LKR Mil)	Yala (LKR Mil)		
	PD	ID	WD	Total	PD	IP	WD	Total				
Paddy	1025	90	-	1115	307	-	-	307	113.3	31.5	74,612	119.3
Maize	-	-	-	-	-	280	36	316	-	48.6	25,310	26.6
Black gram	-	-	-	-	35	-	-	35	-	3.7	2,592	2.5
Green gram	-	17	-	17	33	-	-	33	1.5	2.7	5,920	4.8
Soy bean	-	298	-	298	271	-	-	271	37.2	33.8	73,372	62.9
Big onion	-	-	-	-	-	100	-	100	-	112.5	44,570	54.0

Chilli	-	-	65	65	-	176	20	196	34.3	102.9	68,591	51.6
Vegetables	5	125	-	130	193	-	-	193	70.0	108.2	108,453	112.2
Total	1030	530	65	1625	839	556	56	1451	256.3	443.9	403,420	433.9

Source: JICA Project Team

The proposed production plan yields net incremental incomes of LKR 96,000 and LKR 243,500 per ha in the Maha and Yala seasons, respectively. The incremental labour and capital requirements for production per ha are 46 man days and LKR 87,900, respectively, for the Maha season and 116 man days and LKR 227,700, respectively, for the Yala season.

The production plan for the target area, covering the total command area of 31,446 ha in the 128 cascade systems, was prepared by proportionate extension of the combined plan of the six model cascades.

Table 8.1.4 Proposed Production Plan for the 128 Cascade Systems for Irrigated Area

Crop	Area (ha)		Yield (t/ha)		Production Volume (ton)	National Requirement (NR) (2018 year basis) (ton)	Contribution to NR (%)
	Maha	Yala	Maha	Yala			
Paddy	20,314	5,593	5.75	5.75	148,965	3,461,538	4.3
Maize	0	5,757	-	6.5	37,421	480,000	7.8
Black gram	0	638	1.38	-	880	-	
Green gram	310	601	1.50	1.5	1,367	25,000	5.5
Soybean	5,429	4,937	3.0	3.0	31,098	280,000	11.1
Big onion	0	1,822	-	25.0	45,550	250000	18.2
Chilli	1,184	3,571	2.19	2.19	10,413	60,000	17.4
Vegetables	2,368	3,516	21.25	21.25	125,035	1,500,000	8.3

Source: JICA Project Team

As shown in Table 8.1.4, the production from 128 cascade systems contributes 4.6% of paddy and 15% of the OFC to the total national requirements based on estimates on Agriculture and Production Plan for 2016 – 2018.

Table 8.1.5 Agricultural Income per Household for Irrigated Area Before and After Intervention (LKR)

Maha								
Crop	**Before Intervention**				**After Intervention**			
	Area (Ha)	**GI**	**Cost**	**NI**	**Area (Ha)**	**GI**	**Cost**	**NI**
Paddy	0.95	150,515	98,000	52,515	0.64	141,600	74,011	67,589
Maize	-	-	-	-	-	-	-	-
Black gram	-	-	-	-	-	-	-	-
Green gram	-	-	-	-	0.01	2,400	1,588	812
Soy bean	-	-	-	-	0.17	51,000	30,260	20,740
Big onion	-	-	-	-	-	-	-	-
Chilli	-	-	-	-	0.04	35,050	14,200	20,850
Vegetables	-	-	-	-	0.08	90,000	42,273	47,727
Total	0.95	150,515	98,000	52,515	0.94	320,050	162,332	157,718
Yala								
Crop	**Before Intervention**				**After Intervention**			
	Area	**GI**	**Cost**	**NI**	**Area**	**GI**	**Cost**	**NI**
Paddy	0.25	39,609	25,895	13,714	0.18	39,825	20,816	19,009
Maize	-	-	-	-	0.18	40,950	25,014	15,936
Black gram	-	-	-	-	0.02	4,400	2,305	2,095
Green gram	-	-	-	-	0.02	4,800	3,176	1,624
Soy bean	-	-	-	-	0.16	48,000	28,480	19,520
Big onion	-	-	-	-	0.06	108,000	40,686	67,314
Chilli	-	-	-	-	0.11	96,388	39,049	57,339
Vegetables	-	-	-	-	0.11	123,750	58,125	65,625
Total	0.25	39,609	25,895	13,714	0.84	466,113	217,651	248,462

** GI: Gross Income, NI: Net Income*
Source: JICA Project Team

8.1.3 Livestock Production Plan with Crop Integraton for Profitable Agriculture

As discussed in Chapter 5, the livestock sector requires changes from the traditional free grazing ruminant management system to an intensive management system. It is a compulsory step for the livestock farmer to make this change in consideration of accommodating the process of utilisation of the total arable land area for crop cultivation after the arrival of NCPC water. As confirmed in the verification programmes, the introduction of stall feeding and silage with crop residues, especially maize, is technically feasible and accepted by the model farmers' group.

The survey result revealed that the livestock farmers are 10.8% of the 33,515 farm holdings in the cascade system. Their herd size and number of cow producing milk is 6.6 livestock unit (L.U.) and 1.6 L.U., respectively, in average. The present milk production yield for the lactation period of 190 days per annum is 4.7 L/day and total milk production volume per holding is 1,428 L/year. Total sale of milk is LKR 92,800 and can be considered as their net income per/year/household, as inputs are minimal under the free-range system of management. By the introduction of an intensive farming system in the area, the project proposes to aim to increase the milk production up to 8,100 L per herd per year with the following conditions. The objectives or outcomes of this project are:

- Increase the number of productive cows by 1.5 times whilst the herd size remains the same;
- Increase the rate of crossbred cows up to 75% from 29% at present;
- Reduce the calving interval to 1 year whilst 1.5 years at present;
- Increase the lactation length to 250 days per annum from 190 days at present; and
- Increase the proportion of farmers from 10.8% to 20% at the end of ten years.

The expected changes can be seen in Table 8.1.6 hereinafter. The increment of net income per livestock unit can be expected to increase from LKR 96,172 to LKR 531,450 per annum.

Table 8.1.6 Livestock Production Plan per Livestock Farmer Before and After Intervention

Items	Unit	Before Intervention	After Intervention
Basic parameter			
Herd Size, number of animals	No.	6.6	6.6
Cows in Milk	No.	1.6	2.7
Crossbred percentage		40%	75%
Productivity Parameters			
Average calving interval	days	430	365
Average Lactation length	days	190	250
Average Milk production; per cow per day	L	4.70	12.00
Production parameters			
Total herd annual milk production	L	1,429	8,100
Average dung /organic manure production per animal per year	kg	660.00	990.00
Annual weight of culled animals	kg	300.00	650.00
COST projection			
Cost of Rearing @ LKR 700 per Livestock Unit	LKR	4,620	4,620
Labour cost	LKR	32,951	40,556
Management Cost		950	1,848
Feed cost	LKR	-	60,225
TOTAL COST	LKR	38,521	107,249
BENEFIT projection per year			
Income from culled animals @ LKR 250 per kg Live weight	LKR	75,000	162,500
Annual income from sale of milk@LKR.65.00 per kg	LKR	92,872	526,500
sale of dung / organic manure per herd @ LKR 5.00 per kg	LKR	3,300	4,950
Total Net Income (Profit)	LKR	96,172	531,450

Source: JICA Project Team

It is revealed that there are 3,600 livestock farmers and 5,790 milking cows from the total of 23,800 head of cattle in the 128 cascades in total. The current total milk production from these farmers is 27,000 L/day. The total milk production in the project area will be 54,294,300 L/year. It can contribute 7.2% of the national production target of milk in the country taking into consideration the 2018 target. Table 8.1.7 and Table 8.1.8 shows the milk production target and contribution to national demand and target milestones for milk production after project implementation respectively.

Table 8.1.7 Milk Production in the Target Area and Contribution to National Demand

Total Land Holdings	Livestock Holdings				Milk Production				Contribution to National Demand (%)	
	Before		After		Before		After			
	%	No.	%	No	Yield (L/unit)	Volume (L)	Yield (L/unit)	Volume (L)	Before	After
33,515	10.8	3,600	20.0	6,700	1,428	5,140,800	8,100	54,294,300	0.69	7.20

Note : National requirement is calculated based on National target of 750 million litres per annum (National Food Production Plan 2016-2018)
Source: JICA Project Team

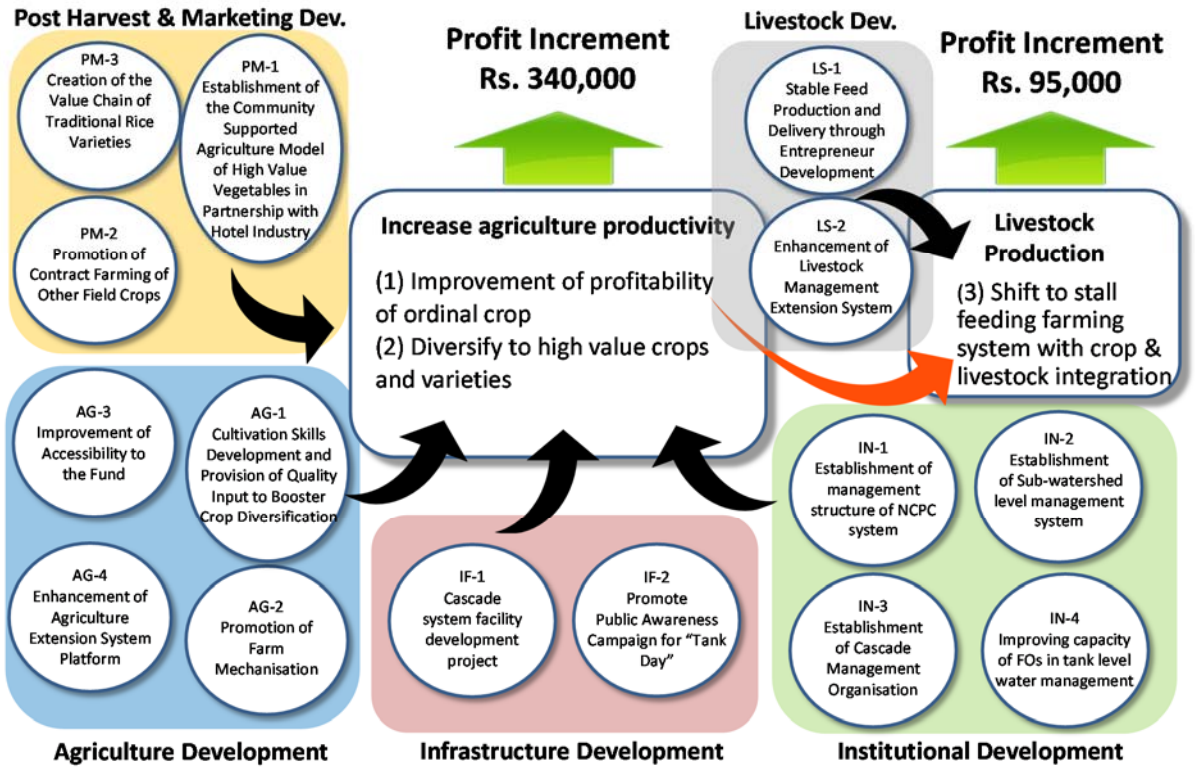
Table 8.1.8 Target Milestone of Milk Production After Project Implementation

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
No. of Livestock Farmers	3,600	3,800	4,000	4,600	5,100	5,400	5,700	6,000	6,200	6,700
Milk Production (M. L)	5.14	6.51	7.88	9.46	16.75	22.77	29.75	36.79	43.28	54.29
Calves Female Retained		1,500	1,500	1,750	2,000	2,500	2,500	3,000	3,000	3,000
Calves Female Sold		300	300	300	300	300	300	300	300	300
Calf Male Culled		200	300	400	450	450	450	450	450	450
Cows Culled			400	400	400	400	400	400	400	400
Sale of Replacement (M. LKR)		18	18	18	18	18	18	18	18	18
Income Live wt. (M. LKR)		2	15	16	16	16	16	16	16	16
Income from Milk (M. LKR)	334	423	512	615	1,089	1,480	1,934	2,391	2,813	3,529
Total Income (M. LKR)	334	443	545	649	1,123	1,514	1,968	2,425	2,847	3,563
Income per Livestock Household (LKR.)	92,700	116,600	136,300	141,100	220,100	280,400	345,200	404,200	459,200	531,800
Income per Total Household (LKR.)	10,000	13,200	16,300	19,400	33,500	45,200	58,700	72,400	84,900	106,300

Source: JICA Project Team

8.1.4 Summary of Proposed Projects

The cascade system development plan proposes 15 projects under the category of infrastructure development, agriculture development, post harvest and marketing development, livestock development and institutional development. The schematic drawing of structure of proposed projects and the list of name, implementing organisation and estimated budget of proposed projects are summarised in Figure 8.1.1and Table 8.1.9 respectively.



Source: JICA Project Team

Figure 8.1.1 Schematic Drawing of Structure of Proposed Projects

Table 8.1.9 Summary of the Proposed Project with Budget

No.	Name of Project	Implementing Organisation	Budget (LKR, Million)
IF-1.	Cascade System Facility Development Project	PDI, NCP and DAD Vavuniya	34,000
IF-2.	Promotion of Awareness Campaign of Tank Day	PDI, NCP and DAD Vavuniya	10
IN-1	Establishment of Management Structure of the NCPC System	MMDE	4
IN-2	Establishment of Sub-watershed Level Management Committee	PDI	14
IN-3	Establishment of Cascade Management Organisation	DAD	240
IN-4	Improving Capacity of FOs in Tank Level Water Management	DAD	40
AG-1.	Cultivation Skills Development and Provision of Quality Inputs to Boost Crop Diversification	PDOA	175
AG-2.	Promotion of farm mechanisation	DOA	120
AG-3.	Improvement of Accessibility to the Fund	DAD Central	300
AG-4.	Enhancement of Agriculture Extension System Platform	PDOA	80
PM-1.	Establishment of the Community Supported Agriculture Model of High Value Vegetables in Partnership with Hotel Industry	PDOA	740
PM-2.	Promotion of Contract Farming of Other Field Crops	PDOA	410
PM-3.	Creation of the Value Chain of Traditional Rice Varieties	PDOA	486
LS-1.	Stable Feed Production and Delivery through Entrepreneur Development	PDAPH	100
LS-2.	Enhancement of Livestock Management Extension System	PDAPH	100

Source: JICA Project Team

Proposed projects organised by the main implementing agencies are shown below.

Table 8.1.10 Proposed Projects by Implementing Agency

Implementing Organisation		No.	Name of Project	Budget (LKR, Million)	
MMDE		IN-1	Establishment of Management Structure of the NCPC System	4	4
DOA		AG-2	Promotion of farm mechanisation	120	120
DAD	NCP and NP	IN-3	Establishment of Cascade Management Organisation	240	7,082
		IN-4	Improving Capacity of FOs in Tank Level Water Management	40	
	Vavuniya	IF-1.	Cascade System Facility Development Project	6,800	
		IF-2.	Promotion of Awareness Campaign of Tank Day	2	
	Central	AG-3	Improvement of Accessibility to the Fund	300	300
NCP	PDI	IF-1.	Cascade System Facility Development Project	27,200	27,219
		IF-2.	Promotion of Awareness Campaign of Tank Day	8	
		IN-2	Establishment of Sub-watershed Level Management Committee	11	
	PDOA	AG-1	Cultivation Skills Development and Provision of Quality Inputs	140	1,513
		AG-4	Enhancement of Agriculture Extension System Platform	64	
		PM-1	Establishment of the Community Supported Agriculture Model	592	
		PM-2	Promotion of Contract Farming of Other Field Crops	328	
		PM-3	Creation of the Value Chain of Traditional Rice Varieties	389	
	PDAPH	LS-1.	Stable Feed Production and Delivery through Entrepreneur Development	80	160
		LS-2.	Enhancement of Livestock Management Extension System	80	
NP	PDI	IN-2	Establishment of Sub-watershed Level Management Committee	3	3
	PDOA	AG-1	Cultivation Skills Development and Provision of Quality Inputs	35	378
		AG-4	Enhancement of Agriculture Extension System Platform	16	
		PM-1	Establishment of the Community Supported Agriculture Model	148	
		PM-2	Promotion of Contract Farming of Other Field Crops	82	
		PM-3	Creation of the Value Chain of Traditional Rice Varieties	97	
	PDAPH	LS-1	Stable Feed Production and Delivery through Entrepreneur Development	20	40
		LS-2	Enhancement of Livestock Management Extension System	20	

Source: JICA Project Team

The outline of the proposed project as categorised basis are described in the following sections.

8.2 Proposed Projects for Infrastructure Development

Two projects, namely: "Cascade System Facility Development Project" and "Promote Communication Campaign for Tank Day" are proposed under infrastructure development. The cascade system facility development project includes all the civil works and procurement of water level monitoring systems proposed in the infrastructure development plan. "Promote Communication Campaign for Tank Day", will contribute proper maintenance of the facilities by promoting joint walk through survey and attending minor repair works with stakeholders on tank operation and maintenance once a year Given all these considerations, the following are the summary of each project:

8.2.1 IF-1 Cascade System Facility Development Project

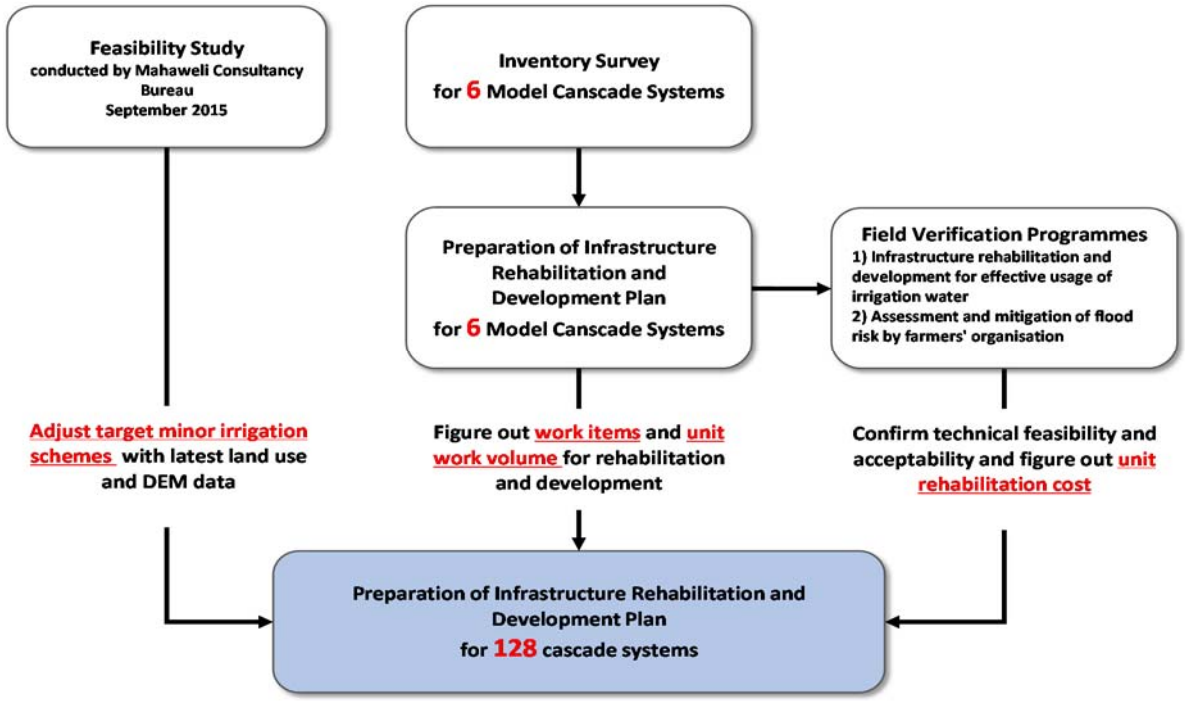
(1) Procedure for Preparation of Cascade System Facility Development Project

The cascade system facility development plan which targets irrigation and drainage facilities and roads in the irrigation command area was prepared based on the result of the inventory survey and field verification programme carried out in the six model cascade systems. As described in Chapter 5 in the development concept, the main purpose of the infrastructure development plan is to utilise irrigation water, including water from the NCP canal, effectively within a cascade system, to prevent farm lands and facilities from flood damage as well as to improve the mobility in and around the farm land.

In order to prepare the practical plan with limited resources, the project identifies the work items and unit work volume in the inventory survey of six model cascade systems at first, then figures out the unit development cost although field verification programmes. Apply the unit data proportionally to 128 cascade systems, the infrastructure development plan for the 128 cascade systems was formulated.

Whilst expanding to 128 cascade systems, the project was updated with the feasibility study data using the latest land use and DEM data.

The workflow of the preparation of infrastructure development plan is shown in Figure 8.2.1.



Source: JICA Project Team

Figure 8.2.1 Work Flow of Preparation of Infrastructure Development Plan

(2) Adjustment of Target Irrigation Schemes

The minor irrigation systems available in the benefit area of NCPCP in 128 cascade systems were adjusted with the latest 10,000 land use map collected from the Survey Department and Digital Elevation Model (DEM) with 5 m mesh purchased from NTT Data Co., Ltd, Japan.

Although 128 cascade systems are specified as a project area of NCPCP, the feasibility study carried out by Mahaweli Consultancy Bureau (Pvt.) Ltd. demarcated the benefit and non-benefit areas of NCPCP within the 128 cascade systems considering the location and elevation of the land. With respect to the benefit area specified by the feasibility study, the number of minor irrigation schemes and command area of scheme were adjusted based on the new land use and DEM data and was used for the preparation of the infrastructure development plan.

The summary of adjustment of the benefit irrigation schemes is shown in Table 8.2.1 and the cascade-wise data and the location map of each cascade system are shown in Attachment 3.

Table 8.2.1 Summary of Adjustment of Benefit Irrigation Schemes under NCPCP

Sub-watershed	No. of Cascade (nos.)	Before Adjustment		After Adjustment	
		Benefit Tank (nos.)	Irrigation Area (ha)	Benefit Tank (nos.)	Irrigation Area (ha)
Malwathu Oya	62	521	15,329	493	14,311
Yan Oya	24	215	7,002	226	7,942
Ma Oya	24	197	6,189	164	4,911
Parangi Aru	16	125	3,821	122	3,324
Kanagarayanaru	2	25	1,277	19	958
Total	128	1,083	33,618	1,024	31,446

Source: JICA Project Team

(3) Work Items and Unit Work Volume

Based on the inventory data for six model cascade systems as summarised in Chapter 6, work items and unit work volume per command area are estimated. The rehabilitation works of the headworks

cover the tank bund reshaping, repair/reconstruction of sluices, improvement and expansion of spillways, and provision of bathing steps. The irrigation canal works cover the formation of canals with trapezoidal earthen canal and construction of related structures with concrete such as farm turnout and drop. Those facilities will enable the conduction of proper and efficient water distribution at the field level. The type of tertiary canal is basically an open canal with reinforced concrete flume type. The type of link canal is proposed either for open canals with a concrete flume for higher discharge or a close canal with PVC for lower discharge. In addition, the improvement of the farm covers the formation of roads with gravel pavements as well as construction related structures such as a culvert.

Table 8.2.2 Summary of Work Items and Unit Work Volume for Headworks and Canal System

Work Items	Unit	Work Volume					
		Alagalla (80 ha) Total (/ ha)	Ichchankulama (372 ha) Total (/ ha)	Kiulekada (313 ha) Total (/ ha)	Naveli kulam (247 ha) Total (/ ha)	Rathmalawewa (469 ha) Total (/ ha)	Siyambalaguswewa (245 ha) Total (/ ha)
Headworks							
Reshaping of Tank Bund	km	2.9 (0.04)	7.4 (0.02)	7.6 (0.02)	9.0 (0.04)	9.0 (0.02)	6.9 (0.03)
Rehabilitation & Expansion of Spillway	m	152 (1.90)	435 (1.17)	339 (1.08)	362 (1.47)	652 (1.39)	381 (1.56)
Provision of Bathing Steps	nos.	5.0 (0.06)	15 (0.04)	16 (0.05)	16 (0.07)	17 (0.04)	12 (0.05)
Rehabilitation of Sluice	nos.	12.0 (0.15)	29 (0.08)	26 (0.08)	26 (0.11)	23 (0.05)	18 (0.07)
Canal Works							
Formation of Canal	km	4.8 (0.06)	16.3 (0.04)	20.7 (0.07)	19.7 (0.08)	24.9 (0.05)	12.3 (0.05)
Link and Tertiary Canal Works							
Construction of Link Canal	km	5.0 (0.06)	10.0 (0.03)	12.5 (0.04)	12.1 (0.05)	11.7 (0.03)	9.3 (0.04)
Construction of Tertiary Canal	km	1.3 (0.02)	2.5 (0.01)	1.5 (0.01)	4.8 (0.02)	8.4 (0.02)	3.4 (0.01)
Farm Road Works							
Formation of Farm Road	km	0.8 (0.01)	6.7 (0.02)	12.4 (0.04)	7.2 (0.03)	4.0 (0.01)	4.0 (0.02)

Source : JICA Project Team

(4) Unit Rehabilitation and Development Cost

Unit construction cost for each work item is figured out based on the actual expenditure for field verification programmes of infrastructure rehabilitation and development for effective usage of irrigation water. The verification programmes target four minor irrigation schemes in the Kiulekada and Navelikulam rehabilitation works. The rehabilitation works include tank shaping, spillway expansion, sluice repair, canal with related structure construction work and link canal construction. The summary of the unit rehabilitation and construction cost are shown in Attachment 6 “Estimation of Unit Cost for 128 Cascade Development”. The unit rehabilitation and construction cost is prepared based on the six model cascade development plan as shown in Attachment 6.

The summary of the unit rehabilitation and construction cost are shown in Table 8.2.3

Table 8.2.3 Summary of Rehabilitation and Construction Cost per Hector for Model Cascade System

Item	Model Cascade Development Cost (M. LKR)						Unit Cost
	Alagalla	Ichchankulama	Kiulekada	Navelikulam	Rathmalawewa	Siyabalaguswewa	
Survey and Investigation	12.550	24.700	29.560	36.850	36.850	24.700	2.466 M. LKR/tank
Preliminary	3.456	9.863	10.811	11.118	12.766	7.294	4.0 % of civil
Headworks	28.411	61.139	65.782	64.961	72.303	47.345	7.986 M. LKR/km
Canal System	15.449	53.234	67.732	64.583	81.606	40.049	3.280 M. LKR/km
Link and Tertiary Canal	41.330	121.585	117.072	137.176	158.859	88.571	8.056 M. LKR/km
Farm Road	1.199	10.611	19.735	11.506	6.392	6.392	1.598 M. LKR/km
Miscellaneous	2.160	6.164	7.093	6.877	7.979	4.952	2.5 % of civil
Monitoring System	3.420	3.420	3.420	3.420	3.420	3.420	3.420 M. LKR/set

Source: JICA Project Team

(5) Summary of Estimated Project Cost

Based on the work items, unit work volume and development cost prepared based on the inventory survey and the field verification programme. The total work volume of 128 cascade systems with the development cost are estimated for each cascade basis. The direct cost including survey and investigation at preparatory stage becomes LKR 33,463 million in total which consist of LKR 6,056 million of headwork related work, LKR 5,755 million of canal system construction, LKR 11,864 million of tertiary and link canal construction and 1,613 million of other works. The summary of the infrastructure development plan is shown in Table 8.2.4 and the breakdown of each cascade system is shown in the Attachment 3.

Table 8.2.4 Summary of Infrastructure Development Plan

Item	Unit	River Basin				
		Malwathu Oya	Yan oya	Ma oya	Parangi aru	Kanagarayanaru
Cascade System	nos.	62	24	24	16	2
Benefit Tank	nos.	493	226	164	122	19
Irrigable Area	ha	14,311	7,942	4,911	3,324	958
Work Volume						
Civil Work						
Headworks	km	345	192	118	80	23
Canal System	km	801	445	272	185	54
Link & Tertiary Canal	km	671	374	228	155	45
Farm Road	km	284	158	97	66	19
Procurement Work						
Monitoring System	set	18	9	5	4	1
Rehabilitation Cost						
Survey & Investigation	M.LKR	631	289	207	154	24
Preliminary Works	M.LKR	233	130	79	54	16
Headworks	M.LKR	2,759	1,536	939	637	185
Canal System	M.LKR	2,622	1,460	892	605	176
Farm Road	M.LKR	454	253	154	105	31
Miscellaneous	M.LKR	146	81	50	34	10
VAT & NBT	M.LKR	1,075	599	366	248	72
New Construction Cost						
Survey & Investigation	M.LKR	585	268	192	142	23
Preliminary Works	M.LKR	216	120	74	50	15
Link and Tertiary Canal	M.LKR	5,405	3,009	1,839	1,249	363
Miscellaneous	M.LKR	135	75	46	31	9
VAT & NBT	M.LKR	996	554	339	230	67
Procurement Work						
Monitoring System	M.LKR	62	31	17	14	4
Total	M.LKR	15,318	8,406	5,194	3,551	993

Note : Management consultant fee is not included
Source: JICA Project Team

(6) Study on Diversion Water Level to Each Cascade System

The project also calculated the diversion water level to each cascade system. At the beginning, the bund top level of upper most tanks of each cascade system were figured out with the DEM data. Deducting two fees of freeboard and 1 foot of overflow depth on the spillway, the crest elevation of spillway was also calculated. Based on the crest elevation of the spillway, the diversion water level was figured out with the following assumptions:

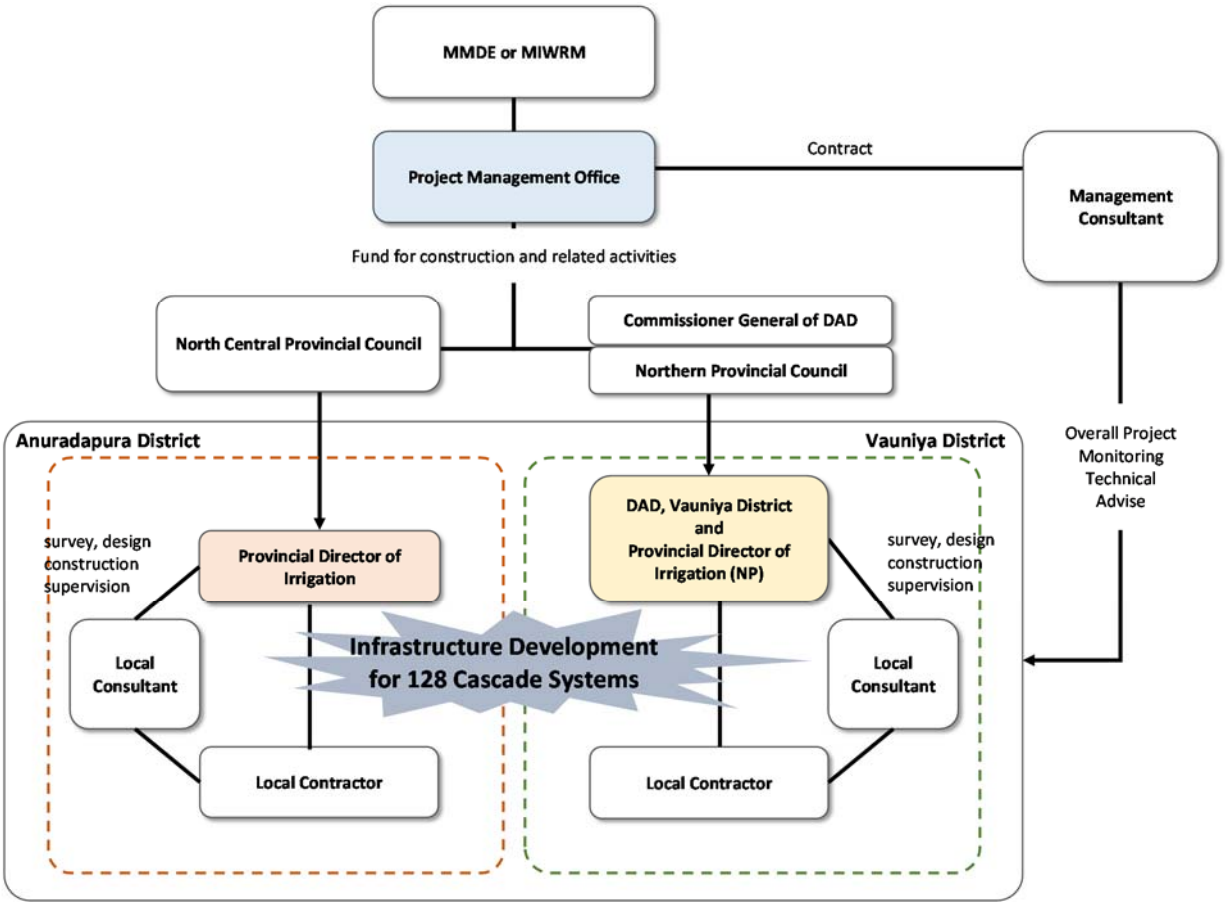
- Distance (1.3 km) from the upper most tank to the division works of NCP canal/branch canal is assumed based on the detailed survey of the six model cascades.
- Longitudinal gradient (1/2,500) is assumed based on the design of the irrigation canals for the verification program.

- Head loss (1 m) including diversion and discharge loss with such a drop structure is assumed.
- Required head (2 m) between the full supply level (FSL) of the upper most tank and the water level of NCP Canal/Branch Canal is assumed based on the distance, longitudinal gradient, and head loss.
- Finally, the required water level is the FSL plus 2 m.

The result of the diversion water level of each cascade system is shown in the Attachment 6.

(7) Implementation Structure

The project management office will be established under Ministry of Mahaweli Development and Environment (MMDE) or Ministry of Irrigation and Water Resources Management (MIWRM). Since the tank irrigation systems are managed by different departments between Anuradhapura and Vavuniya districts, it is proposed to set different organisations for project implementation. The project fund for civil works, procurement of water level monitoring system and other facilities, consulting services, and other administrative works will be provided through the Director General of Irrigation or the Director General of Mahaweli Authority to Provincial Director of Irrigation (PDOI) in Anuradhapura District and through Commissioner General of Department of Agrarian Development to Assistant Commissioner of Department of Agrarian Development (ACAD) in Vavuniya District and . In addition, the Regional Director of Irrigation Anuradhapura Office will also be involved, if necessary. Both PDOI and ACAD will carry out the civil works and survey, design and construction supervision will be contracted out to the local consultants. The civil works should be packaged out for each cascade system and local contractors will attend to the construction works. The plan proposes to hire the management consultant to monitor financial and physical progress of the works as well as to give the technical advice needed to all the parties involved. The proposed implementing structure of the cascade system facility development project is shown in Figure 8.2.2.



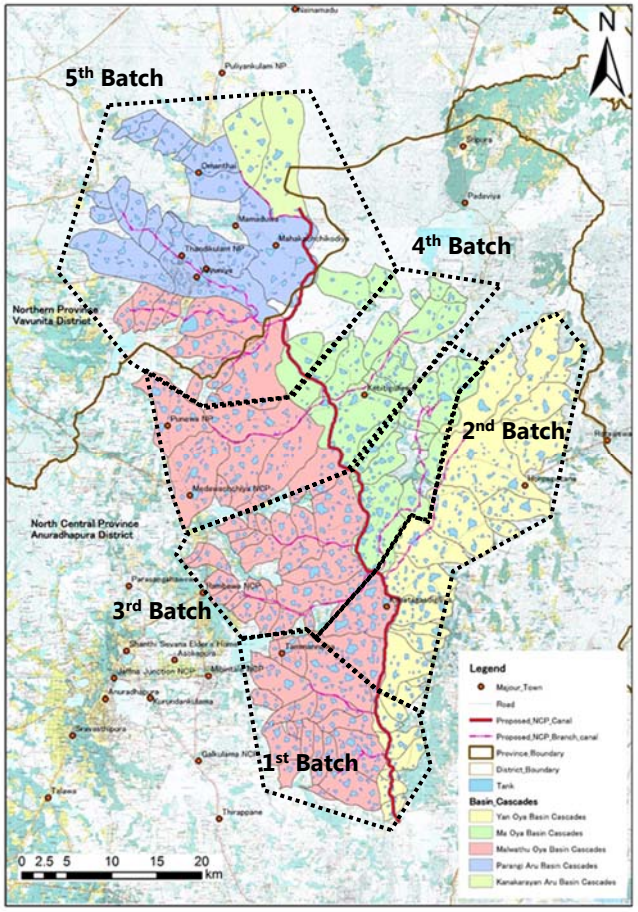
Source: JICA Project Team

Figure 8.2.2 Implementation Structure for Cascade System Facility Development Project

(8) Implementation Schedule

Although two type of components namely existing tank and irrigation canal system rehabilitation works and new construction works for link canal and tertiary canal are proposed, both components should be implemented in the one project since two components are vital to storing and delivering NCPC irrigation water effectively to achieve the project objectives. However, considering the early implementation of the project, civil work components should be divided into two and existing tank and canal system rehabilitation work which is not affected any design parameters of NCPC main and branch system should be commenced early. The other component of construction of tertiary canal and link canal with the installation of a water level monitoring system which is affected by the design parameters of NCPC main and branch system will be implemented later.

The proposed implementing schedule for the cascade system facility development project is shown in Figure 8.2.4. With the assumption that all the design parameter of NCPC main and branch canal system are fixed in the middle of 3rd year, the tertiary and link canal construction work is planed to commence after fourth year.

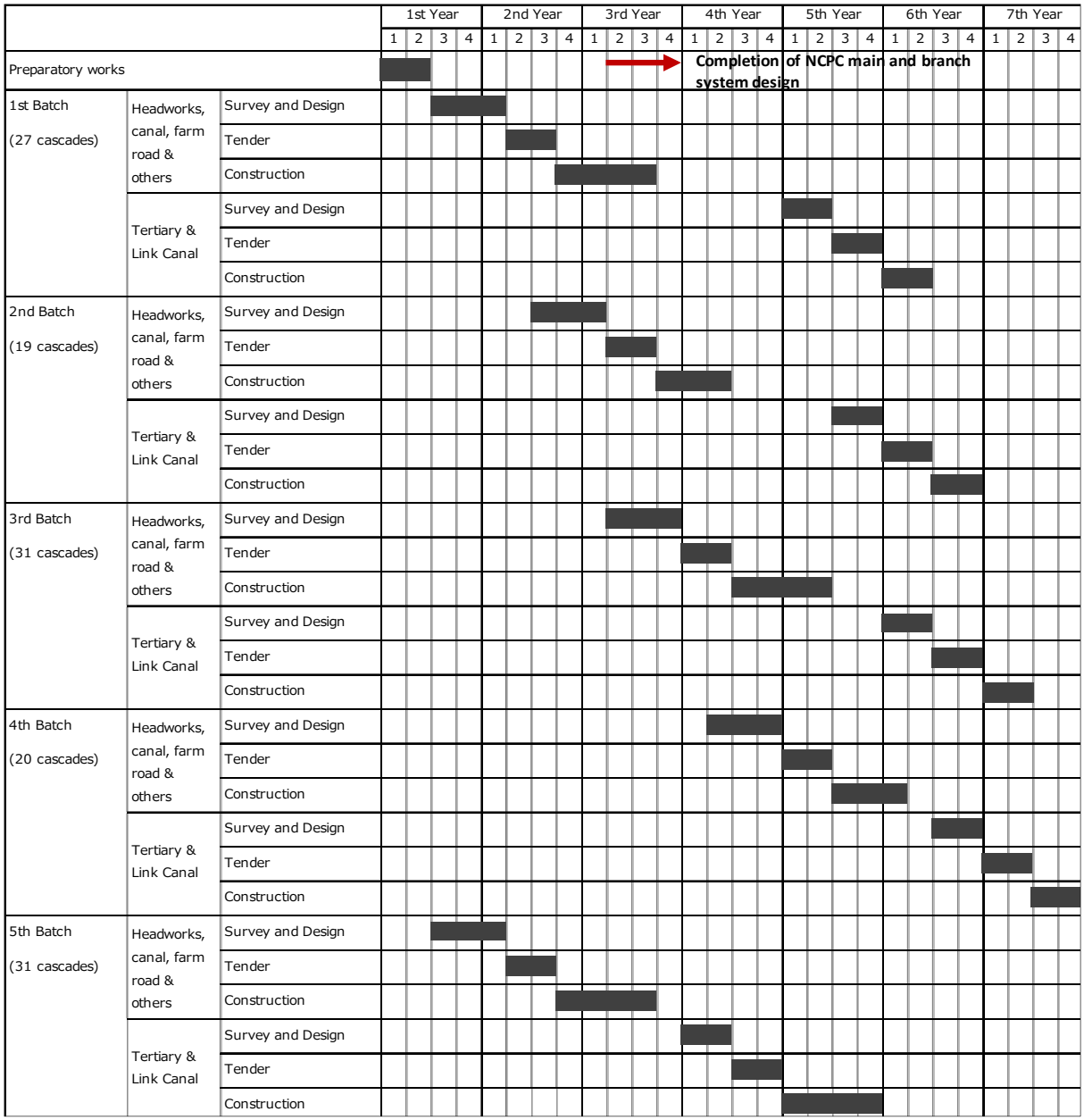


Source: JICA Project Team

Figure 8.2.3 Stage wise Construction Plan

Considering the present implementing capacity of the PDI NCP and DAD Vavuniya, stage-wise implementation with cascade basis is proposed. The 128 cascade systems are divided into five batches based on the diversion points of branch canal as shown in Figure 8.2.3. The 1st to 4th batch cover 100 cascade systems located in Anuradapura District while the 5th batch mainly covers cascade systems in Vauniya. Number of the cascade systems covered by each batch are 27 in 1st batch, 19 in 2nd batch, 31 in 3rd batch, 20 in 4th batch and 31 in 5th batch respectively. With considering the implementation capacity for 15 cascade systems for each year

The proposed stage wise construction plan is prepared based only on commencement of physical water supply to the area (ex. upstream to down stream) and implementing capacity of relevant organizations. The actual implementation plan should be prepared considering regional, economical and social benefit distribution balance in the area.



Source: JICA Project Team

Figure 8.2.4 Implementation Schedule for Cascade System Facility Development Project

8.2.2 IF-2 Promote Public Awareness Campaign for "Tank Day"

Main Implementing Agency: PDI and DAD

Project Period: Three years

Target Group: CMO and DAD

Project Purpose: Ensure proper maintenance of the irrigation and drainage facilities

Project Contents:

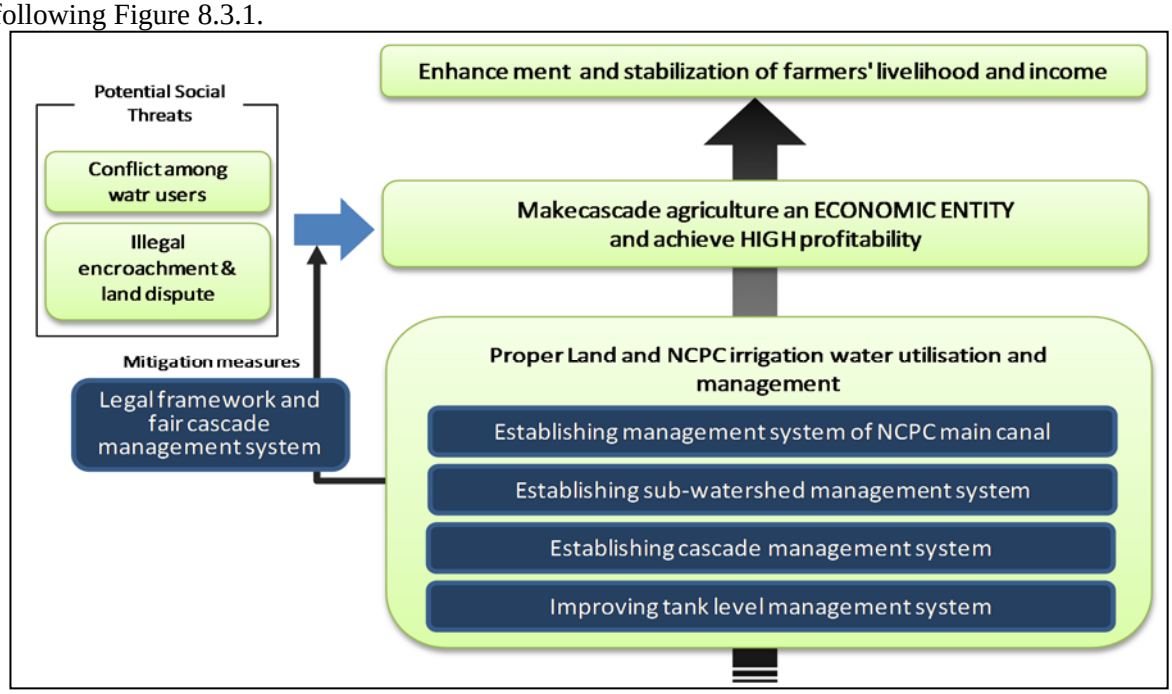
Regular identification and proper assessment of the risks for collapse of tank bund and other facilities as well as early repair and maintenance of the structures and facilities will be key for keeping the sustainability of the irrigation system. As confirmed in the verification programme of "assessment and mitigation of flood risk by farmers (FO)" the importance of those are recognised by farmers and officers, and thus activities are not well implemented due to the lack of knowledge, technical guidance from resource persons and lack of initiative of both the government and farmers.

Considering the situation, the project proposes to have an awareness campaign to conduct walk through surveys and repairing works of the damaged tank on a specific day of the year. The specific

day will be promoted as a "Tank Day" in the target area.
On Tank Day, officers will give lectures about the mechanism of tank collapse, the importance of timely assessment as well as typical method of repair. After having the lecture, all the participants will walk on the tank bund and jointly inspect the condition of the tank. The participants will also attend the minor repair works based on the inspection results on the same day. The participants are mainly farmers but other village stakeholders such as school students, village leaders, religious leaders, youth organisations, and women organisations are also invited to attend.
The activity includes awareness training to members of the FO or CMO to use a "Check sheet for inspection" which will be developed under the verification programme. In addition, preparation of leaflets and posters, preparation of promotion movie, establishment of website and broad cast the information through radio, TV, or other communication channels will be implemented.

8.3 Proposed Projects for Institutional Development Plan

The institutional development of the project will tackle one of the crucial parts of the project concept which is "realising proper land and NCPC irrigation water utilisation and management". The institutional development shall also mitigate potential threats regarding social issues that may disrupt the bigger objective of the project; making a cascade agriculture an economic entity and achieving high profitability. Therefore, the institutional development in the project can be defined as the "establishment of efficient water management system of the NCPC for profitable agriculture". Approaches and roles of the institutional development in the project components are shown in the following Figure 8.3.1.



Source: JICA Project Team

Figure 8.3.1 Approach and Roles of Institutional Development in the Proposed Projects

The institutional development for cascade management needs to be prepared in consideration of the whole NCPC management. The institutional set-ups for the NCPC should be established at different levels of the NCPC, namely; the main canal, branch canals to tertiary canals, and cascades. Since the NCPC system involves existing systems such as the Mahaweli system and minor irrigation systems, the management of the NCPC shall be applied to the existing systems as much as possible with necessary adjustments concerning relationship between the systems, prioritisation between them, and coordination between them.

From this point of view, the institutional development plan shall consist of the following four components; 1) the establishment of the NCPC main canal management system under the Mahaweli system, 2) the establishment of sub-watershed management system lead by the PDI, 3) the establishment of the cascade management system as well as the following minor irrigation systems, and 4) the capacity building of the existing FOs.

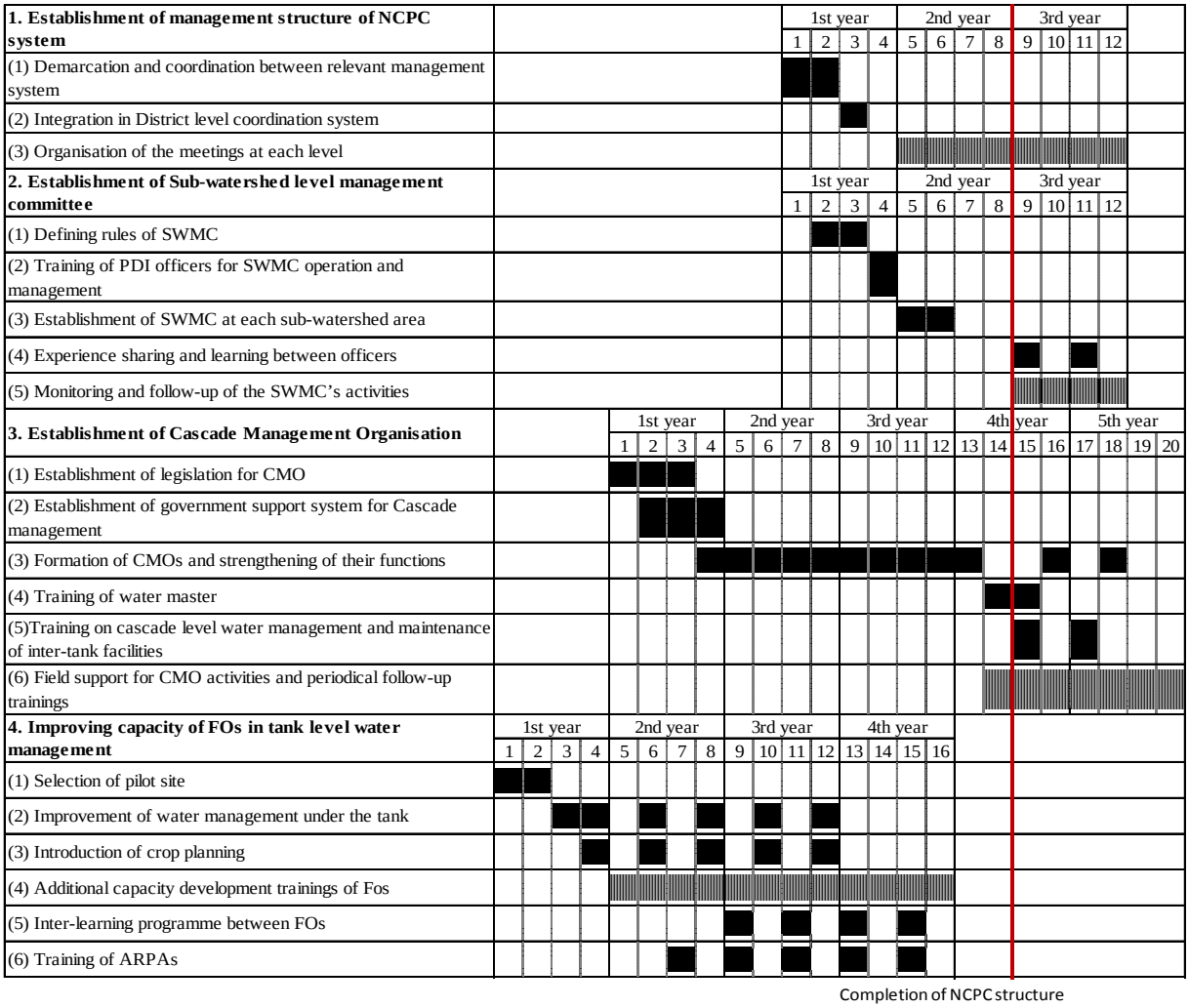
The outline of the four projects is summarised below.

Table 8.3.1 Outline of Proposed Projects under Establishment of Efficient Water Management System of NCPC for Profitable Agriculture

No.	Name of Project	Implementing Organisation		Project Period	Target Group
		Main	Sub		
1-1	Establishment of Management Structure of the NCPC System	MMDE	MASL, MIWRM, PDI, DAD DoI	3 years	MMDE, MASL, MIWRM, PDI, DAD DoI, GA, SWMC, CMO
1-2	Establishment of Sub-watershed Level Management Committee	PDI	DoI, DAD, DS	5 years	PDI, DAD DoI, DS officers in-charge
1-3	Establishment of Cascade Management Organisation	DAD	PDI, DoI, DoA, GN	5 years	FOs under the target cascades, DAD field officers
1-4	Improving Capacity of FOs in Tank Level Water Management	DAD	PDI, DoI, DoA, GN	4 years	FOs under the pilot sites of the target cascades

Source: JICA Project Team

Institutional set-ups shall be established before the completion of the NCPC physical structures in order to start operation as soon as the irrigation structure is completed. All the management systems shall be prepared in parallel for their immediate function after NCPC water distribution starts. Since the establishment of the CMOs takes time starting with preparation of legislation as well as awareness raising of farmers on cascade management, it shall start much prior to the completion of the NCPC. Capacity building of the existing FOs can be started during the current situation as it can improve water management of drought situation faced in the target area. Figure 8.3.2 proposes the overall schedule and association between the projects under the institutional development sector.



Source: JICA Project Team

Figure 8.3.2 Overall Schedule for Institutional Development for NCPC Management

The proposed four projects are summarised below.

8.3.1 IN-1 Establishment of Management Structure of the NCPC System

Main Implementing Agency: MMDE in collaboration with MIWRM

Project Period: Three years

Project Purpose: Establishing a government structure to coordinate management bodies at different levels of the NCPC for efficient water distribution.

Project Contents:

The project aims to establish efficient water use through a comprehensive management system of the NCPC as a whole, which, when implemented, will contribute to develop agricultural economic entities under cascades. Since the NCPC system involves different existing systems with different responsible authorities, coordination and integration of those systems are necessary. This project has an important role in defining the application of the existing systems at different levels of the NCPC system as well as demarcating the roles of the concerned authorities. Overall rules and administration system for total operation of the NCPC shall be established with initiative of the MMDE in collaboration with MIWRM. Since several different government departments are involved in different parts of the NCPC, demarcation of the roles between the government departments shall be finalised through the following activities of the project with reference to the proposed division of roles mentioned in Chapter 5.3.

The activities of the project mainly consist of formation of rules and establishment of administration structure for management of NCPC, which shall be fully disseminated and understood by the concerned officers who are involved in the NCPC operation. Major activities are:

(1). Demarcation and coordination between relevant existing management systems and dissemination of the defined coordination system;

(2). Integration in district level coordination system; and

(3). Organisation of the meetings at each level of the NCPC system.

Issues to be defined and established are as follows:

(1). Operation system and responsible authorities at each level of the NCPC system namely the main canal, branch to tertiary canal and cascade.

(2). Coordination system between the different levels of the NCPC system.

(3). Roles of the relevant government agencies in the NCPC management.

8.3.2 IN-2 Establishment of Sub-watershed Level Management System

Main Implementing Agency: PDI of the concerned province

Project Period: Three years

Project Purpose: Establishment of Sub-watershed Management Committees (SWMCs) are formed with the operation of water distribution at the NCP branch canals

Project Contents:

Sub-watersheds of the NCPC should be managed by establishing and operating the SWMC headed by PDI. The project consisting of the following activities shall be implemented in collaboration with the NCPC main canal management, the cascade management, as well as the sub-watershed management who has an important role as a link between them.

(1). Defining roles of SWMC

(2). Training of PDI officers for SWMC operation and management

(3). Establishment of SWMC at each sub-watershed area

(4). Experience sharing and learning between cascades amongst the SWMC for better coordination

8.3.3 IN-3 Establishment of Cascade Management Organisation

Main Implementing Agency: DAD, supported by PDI

Project Period: Five years

Project Purpose: CMOs are established and manage cascade systems and cascade level water distribution

Project Contents:

The establishment of the cascade management system is crucial for the effective use of the NCPC in the field. DAD takes the lead in training its field officers for the establishment of the CMO. The following activities are to be conducted in order to establish the CMO and its management:

(1). Establishment of legislation for the CMO formation and operation;
(2). Establishment of the government support system for cascade management;
(3). Formation of the CMOs and strengthening of their functions;
(4). Training of water master on cascade water management;
(5). Training on cascade level water management and maintenance of inter-tank facilities, and
(6). Field support for the CMO activities and periodical follow-up trainings.

As per mentioned in the survey results, there are several issues that require special attention in establishing CMOs. The following issues should be emphasised in the implementation of the above activities:

1). Legislation of the CMO is critical for effective and sustainable operation of the CMO as per seen with the Agrarian Development Act for FOs' operation. Administrative rules of the CMOs' operation should be prepared and executed. The operational rules shall include regulations to prevent potential negative impact caused by social relations and situations.

2). Identification of risk factors in formation of the CMOs and necessary counter actions are crucial for democratic and sustainable management of cascades. Major risks to be identified are:

- Cascade crossing over ASC divisions;
- Existence of minority population;
- Cascade with a large number of FOs;
- FOs covering more than one cascade;
- Lower Bethma practice;
- Observed problem/dispute between FOs; and
- Existence of inactive FOs.

Field officers to support CMOs should be trained well in dealing with these risk factors on the cascades.

3). Water delivery within the cascades shall be controlled by the appointed cascade water masters. Management and capacity building of the water master is critical in fair and efficient water distribution, in addition to the water distribution plan to be prepared by CMO. The water master shall be trained through PDI using the water distribution model based on the water distribution model described in Chapter 7.

CMO is responsible for maintenance of inter-tank facilities with technical assistance of PDI. The training programmes of CMO include maintenance of the cascade level irrigation facilities.

4). Improvement of crop planning at each tank will be essential for the cascade water management, based on which the water requirement should be calculated. Training on crop planning shall be included for preparation of the water distribution plan in the CMO training programmes in collaboration with the agriculture project and support of the DOA.

Further details are explained in the attached project sheet in Attachment 5.

8.3.4 IN-4 Improving Capacity of the FOs in Tank Level Water Management and Maintenance

Main Implementing Agency: DAD, PDI

Project Period: Four years

Project Purpose: FOs became capable enough to maximise agricultural profit with limited water sources through effective support from ARPA

Project Contents:

Capacity development of the existing FOs is necessary based on the following point of views; 1) the need for effective and efficient water use from the NCPC, 2) the need for improvement of organisational functions to manage the FO under the cascade system 3) the need of improvement of the tank level water distribution with improved irrigation system, 4) the need of improvement of the water management in the present situation of water scarcity and drought situation, and 5) the need for developing agriculture related collective activities as an FO for profitable agriculture activities.

The programme for capacity building of the FOs shall be conducted in the selected pilot cascade areas, with the following activities:

(1). Selection of pilot cascades and identification of the target FOs;

(2). Improvement of water management and maintenance of facilities under the tank;

(3). Introduction of crop planning;

(4). Additional need-based trainings for FO's capacity improvement; and

(5). Inter-learning programme between FOs.

(6). Training of ARPAs

Additional need-based trainings can include institutional support on development of agriculture related activities with the FOs in collaboration with the agriculture and marketing projects.

Support for improvement of FO's capacity are to be carried out by the DAD officers in charge. Therefore, all the programmes involve field-level DAD officers especially ARPA as their learning opportunity. ARPAs from outside the pilot areas shall be equipped with the skills to support FOs of their area through the learning from pilot areas as well as the training programmes.

8.4 Proposed Projects for Agriculture Development

The plan proposes three projects for improvement of agriculture productivity and production as follows:

8.4.1 AG-1 Cultivation Skills Development and Provision of Quality Input to Boost Crop Diversification

Main Implementing Agency: PDOA and Agribusiness Enterprises

Project Period: Five years

Target Group: Famers in CMO

Project Purpose: Ensure crop diversification through enhancement of cultivation skills for high-value vegetables, OFCs, and traditional and new variety of paddies and provisions of quality seeds and planting materials.

Project Contents:

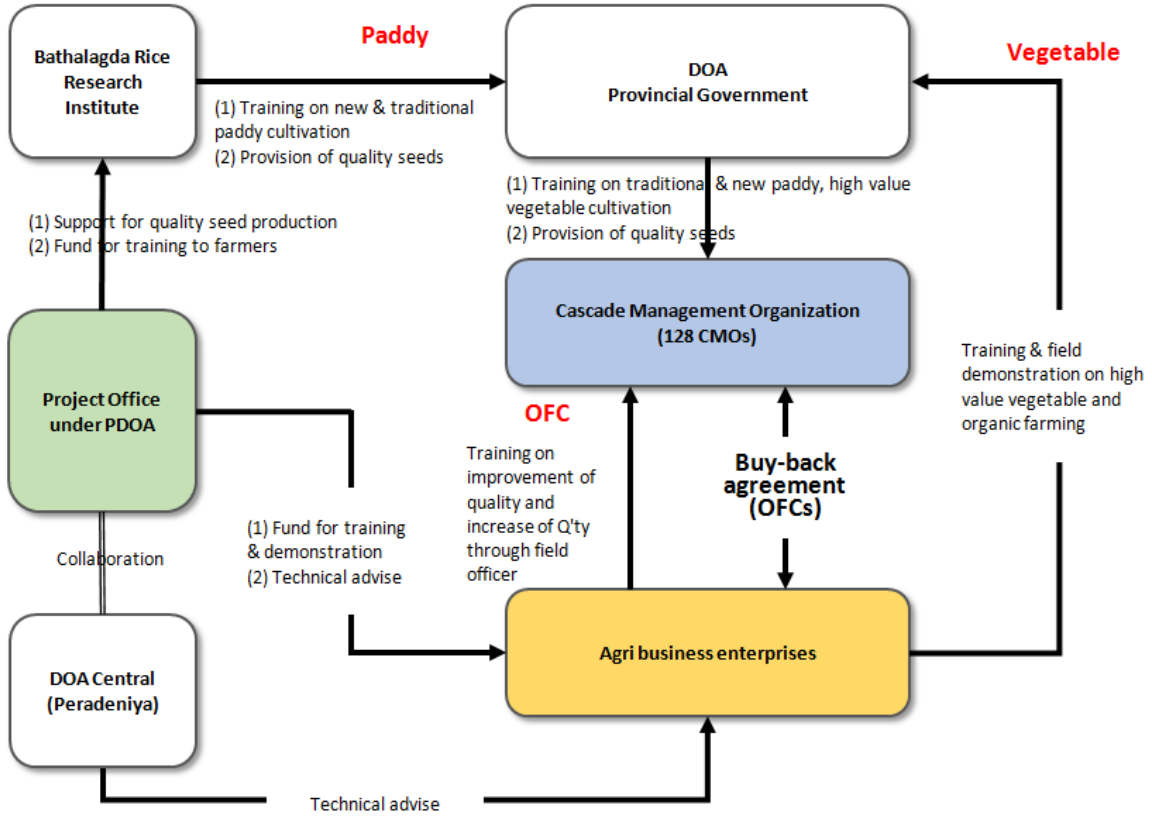
Nominal and high-value crops are included in the cropping patterns for the target area. Except for paddies, other crops are cultivated under rain-fed conditions in the highlands because most farmers lack previous experience in growing them under irrigation in the command area. The productivity of the nominal crops remains less that those recorded in the major irrigation schemes in the district. With assured irrigation water supply and an effective extension delivery system, it is necessary to promote adoption of improved practices in crop production by the farmers in order to reach the targeted productivity levels. There are a number of national level programs as well as provincial level programs based on training needs identified through pre-seasonal Provincial Technical Working Group (PTWG) conducted by the PDOA in collaboration of the Department of Agriculture (DOA). Majority of the training programs of PDOA targets paddy cultivation since it is the main crop cultivated in the area.

Contract farming based on buy-back agreements between farmers and major agribusiness entrepreneurs and processors of maize and soybean are already in operation in parts of the target area. These agreements often include provision of technology packages in the form of inputs such as seeds and advice to farmers.

With regard to high-value crops, condiments and vegetables proposed under the project, there is little or no provision for technology transfer as they are either insignificant in terms of extents cultivated or are relatively new to the area. The situation exemplifies the need to develop production skills of the farmers for cultivation of the crops, OFCs, and vegetables in particular, under irrigation in the tank command

areas. The project proposes to provide technical advice and financial support to the Rice Research and Development Institute, PDOA, and agribusiness enterprises in support of the project. Besides productivity, the next most important aspect in crop production is the product quality which relates to the appearance (shape, size, colour, etc.) and safety (free of harmful agrochemicals). It is also reported that the postharvest handling loss of vegetables is about 35%, which is very high and needs to be minimised. The farm inputs basically include seeds/planting materials, fertilisers, and agrochemicals. Availability of high quality farm inputs at the correct time and in required quantities is crucial for successful crop production as well implementing a sustainable crop diversification program.

Registered seed paddy is issued to farmers by PDOA for demonstration, multiplication and for use in the next seasons whilst Department of Agrarian Development (DAD) and private traders supply about 60% of the certified seed paddy requirement secured from government seed farms and private seed producers. The project underlines the need to introduce traditional paddy varieties and newly released high-value paddy varieties. Seeds of OFCs and vegetables as well as fertilisers and agrochemicals (mainly herbicides and insecticides) are supplied by the private sector dealers operating from towns in the area. They serve as agents of importers and state agencies. The implementing organisation of the project is shown in Figure 8.4.1.



Source: JICA Project Team

Figure 8.4.1 Implementing Structure of Cultivation Skills Development and Provision of Quality Input to Boost Crop Diversification

8.4.2 AG-2 Promotion of Farm Mechanisation

Main Implementing Agency: DOA

Project Period: Five years

Target Group: Cascade Management Organisation (CMO) and young villagers' group

Project Purpose: Ensure crop diversification through promotion of farm mechanisation

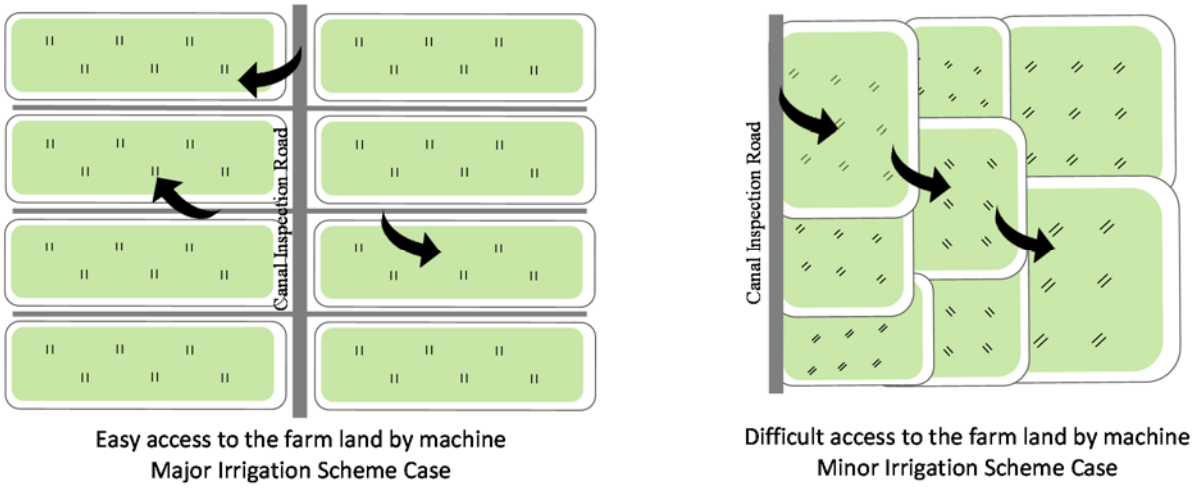
Project Contents:

The project provides technical and financial support for changing the farming management system to suit mechanization and to promote young entrepreneurs engaged in light engineering works to take up

fabrication of low cost farm machinery and equipment.

Labour requirement for paddy cultivation has come down during the past decades mainly as a result of mechanisation. Yet, scarcity of labour for crop production is identified as a major problem by the majority of the farmers. Average household contribution to farm labour of two units, as revealed from the detailed surveys, is inadequate to meet the requirement at peak periods where completion of specific farm operations are often time bound. Increased cropping intensity and cultivation of labour intensive high-value crops will further aggravate the problem.

The farm land allotments in minor irrigation schemes are small in size and not uniform in shape as compared with other major schemes. Basically, the irrigation and access to the particular farm plot is made via the other farm plots adjacent to it. Therefore, any farming activities are subject to the adjacent farm plots activities as well. These limitations will be a major constraint for farmers and service providers in the promotion of effective farm mechanisation in this area.



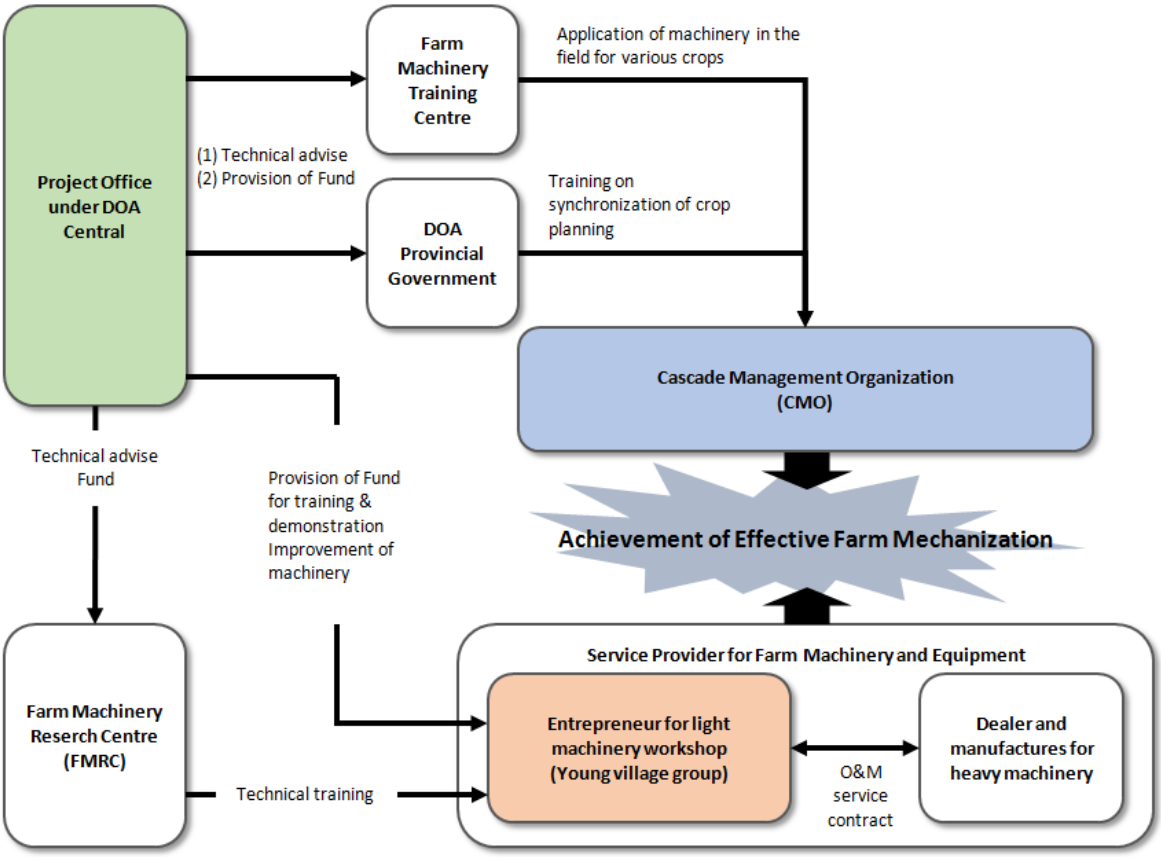
Source : JICA Project Team

Figure 8.4.2 Difference in Accessibility to Farm Plot by Type of Scheme

To overcome this condition, it is required to change the farming management to suit mechanisation. The farmers should synchronise the cropping pattern and type of crops in a particular area to facilitate the mechanisation without disturbing adjacent farmers. If the area is large, for example on a cascade basis, the scale of operation merits both farmers and the service providers to ensure optimal operational efficiency of mechanisation. Some machineries and equipment, although not used extensively by the farmers, are already available in the country. They are designed for small-scale operation to fit the small plot sizes in minor irrigation schemes often as attachments to 2 or 4 wheel tractors and include seeders, transplanters, bed making machines, inter-cultivators, harvesters, pod separators, de-coaters, etc. Furthermore, there is a need to introduce new machinery and equipment, imported or locally manufactured, after their field testing and certification, supported by continuous upgrading, to improve performance in specific field conditions.

The project proposes, both technically and financially, to develop the technical and management capacity of Cascade Management Organisation (CMO) on synchronisation of cultivation planning and monitoring. Furthermore, creating awareness among farmers on the range of machinery and equipment available, which are labour saving as well as cost effective, for adoption by farmers particularly for production of non-paddy crops is encouraged. This will be promoted through exhibitions, field demonstrations and training. There are light engineering workshops functioning in the target area. The young entrepreneurs are encouraged to expand their operations to include fabrication of selected low cost farm machinery and equipment for sale to farmers and thereby support the drive towards farm mechanization. For this purpose, the required training and advice along with technical backup with engineering drawings are available with the Farm Machinery Research Centre and Farm Machinery Training Centre. Farm machinery and equipment require trained operators as well as regular servicing, repair and maintenance for extended service life.

The implementing structure is shown in Figure 8.4.3



Source : JICA Project Team

Figure 8.4.3 Implementing Structure for Promotion of Farm Mechanisation

8.4.3 AG-3 Improvement of Accessibility to Fund

Main Implementing Agency: DAD Central

Project Period: Five years

Target Group: Famers in CMO

Project Purpose: Enable the farmer who is interested in starting a crop diversification to access the fund

Project Contents:

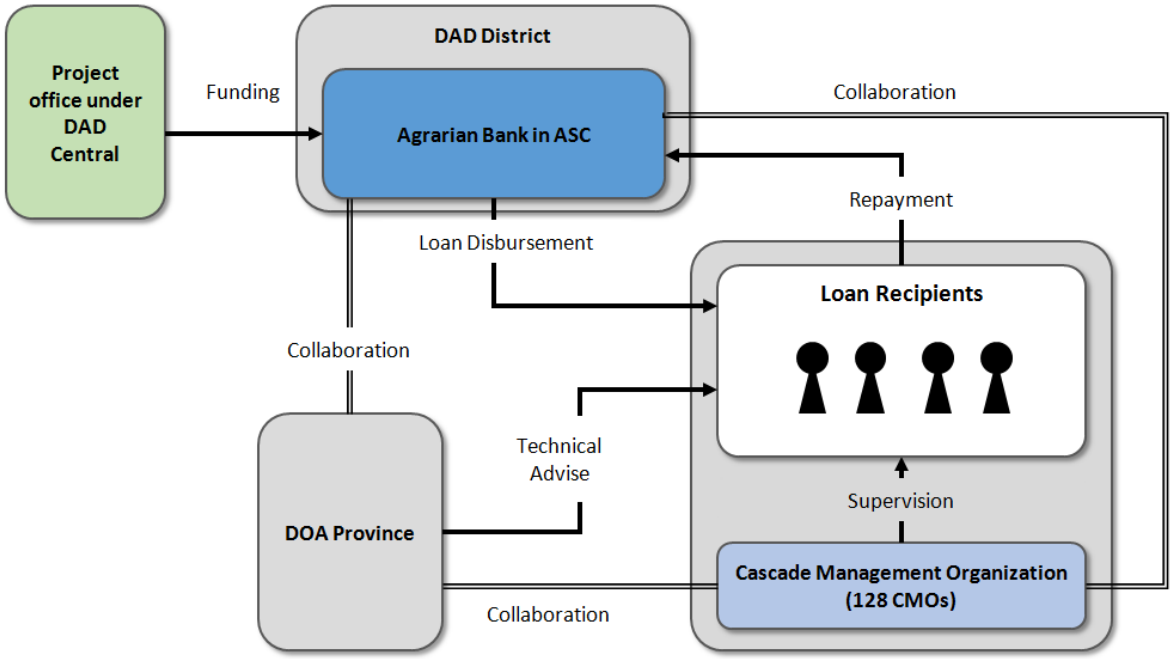
The expansion of the cultivation with crop diversification requires additional capital for farmers with LKR 87,900 in Maha and LKR 227,700 in Yala. As described in the previous section. The central DAD will provide fund for agrarian banks in target area.

The Regional Development Department of the Central Bank of Sri Lanka (CBSL) delivers agricultural credit to increase food production and ensure food security through the New Comprehensive Rural Credit Scheme (NCRCS) or "Sarusara". The NCRCS is managed by the Participating Financial Institutions (PFIs) with their own funds. An interest subsidy of 6% for cultivation loans, 2% per annum for purchasing loans to PFIs and a credit guarantee up to 60% of the losses of the PFIs is payable by the CBSL. The scale of finance is determined in consultation with the Ministry of Agriculture on seasonal basis and the maximum limit per borrower is LKR 500,000. Excluding paddies, commercial scale crop production in the command area of the cascades under irrigation in the project is a new experience to farmers. In this situation, the position of the formal lending organisations with regard to granting of cultivation loans is not clear.

The Agrarian Banks under the DAD operates in accordance with the departmental circular No. 04/2112 at all the ASCs in the target area. The main objective of the Bank is poverty alleviation of the rural peasant community by assisting them to access required capital and to promote savings. A number of credit schemes are operated which include cultivation loans and project loans. Initial capital needs for the program is provided by the center, but many banks have already paid up the original capital and are now operating with their own funds accumulated from loan interest, deposits, shares and small groups.

Under the agricultural loan scheme, loans area granted for paddy, soya bean, black gram, maize, cowpea and green gram (LKR 15,000/ac), Chilli (LKR 25,000/ac), Onion (LKR50,000/0.25ac) and vegetables (LKR 25,000/0.5ac). Field supervision is entrusted to the ARPSs and assisted by the respective Agrarian Bank Officers and the DOs. Recovery rate has been very good and if repayment by few defaulters, after internal rescheduling failed, cases are filed in courts.

It is apparent that the operational system of Agrarian Banks is more appropriate and farmer friendly. It is therefore proposed to use to use Agrarian Banks as the principal lending agency of agricultural credit to farmers. As per recommendation of DAD, farmers trust fund governed by DOA shall be also considered as an available fund for farmers. Additional capital funds will be required for disbursement among a larger recipient farmer base after the intervention. This will be channeled through the steering committees at the national and district levels to the Govijana Bank Project operating at ASCs in the target area for disbursement among individual farmers. The PDOA will work in collaboration with the District DAD and ASCs on provision of extension services and determination of crop-wise credit limits. Overall supervision on the correct use of the funds dispersed to individual loan recipients is the responsibility of the respective Community Management Organizations. Operational details would be finalized after discussion with the DAD and the CMOs.



Source : JICA Project Team

Figure 8.4.4 Implementing Structure of Improvement of Accessibility to the Fund

8.4.4 AG-4 Enhancement of Agricultural Extension System Platform

Main Implementing Agency: PDOA

Project Period: Five years

Target Group: Staff of PDOA

Project Purpose: Establish firm agriculture extension system platform to increase the agriculture productivity and production

Project Contents:

Delivery of government extension services to farmers in the target area comes under the purview of the PDOAs of the North Central and Northern provinces. Few exceptions are observed where the services are provided by the Interprovincial DOAs. The Provincial and Interprovincial DOAs are vested with duties pertaining to national interest as well as implementation of provincial programmes developed by Provincial Technical Working Group (PTWG) on seasonal basis.

To materialize the expected transformation from a paddy-centric cropping system to sustainable

diversified cropping patterns in the command areas requires a concerted effort and work commitment by the extension workers. While skills development of the government officers on crop diversification are addressed in the project of "Cultivation Skills Development and Provision of Quality Input to Booster Crop Diversification", this project focus on enhancement of basic extension system platform..

(a) Mobility of the Extension Workers

Each Agricultural Instructor operating in the ranges from office in ASCs are assigned to cover large service area (100km2) and number of farm households (3000). The AIs often found the allocated allowance for travelling is inadequate to provide an effective service to the farming community. It is therefore necessary to examine the alternative extension methods that would minimize the burden on AIs while maintaining the effectiveness of the technology transfer system.
Systematic utilization of Farmer-to-Farmer (F2F) extension system as an effective community based approach is recommended. F2F system involves careful selection of suitable lead farmers from the community and provision of comprehensive training on production technologies, sustainable production and value addition for sharing the acquired knowledge with fellow farmers. The system expands the extension outreach, low cost/cost effectiveness and promotes increased participation of local communities. Other means of meeting the cost of travelling may include (1) introducing a system of charging a nominal fee from farmers for services rendered and (2) supplementing the present payment applicable to the range AI.

(b) Introducing an Effective Communication System

Communication system between the PDOA office through the segment offices (ADA) ranges offices (AI) and the farmers is weak and much time is wasted in the exchange of information. It is therefore proposed to develop a suitable software program to improve communication among the stakeholders.

(c) Establishment of a Collaborative Extension Mechanism

It is proposed to establish a collaborative extension platform with all the contributors to the system of which the major private sector partners are listed below.

- Commodity extension organizations or agribusiness entrepreneurs /processors providing crop based extension on contract buying agreements.
- Service providers including suppliers of machinery and equipment on hire basis, suppliers of farm inputs such as seeds and planting materials, fertilizers, agrochemicals, etc. and market players including collectors, Paddy Marketing Board, commission agents in dedicated economic centres.
- Private sector establishment specializing in production of high-value vegetables for technical backup and transfer of technologies to the farmers.

It is anticipated that the arrangement would be complementary and reduce the additional workload of the extension workers (AIs) as well as to overcome the limitations faced by PDOA with regard to human and financial resources.

8.5 Proposed Project for Postharvest and Marketing Development

Proposed crops for diversification are selected considering present national and market demand as described in the above section. However, proper agriculture marketing and postharvest strategies and plans are required to achieve the development goal. The farmers in the NCPC target area have developed an affiliation towards conventional agricultural practice, mainly of paddy, and continued through decades of strong governmental support. However, the rice sector has reached the self-sufficient level, and the expansion of paddy cultivation may not bring enough profit to the farmers. Sri Lanka requires a large fund allocation from the national budget for sustaining related subsidies such as price protection, storage and distribution management. In order to maximise utilisation of limited resources and minimise the burden on national budget, farmers in the NCPC area need to raise their entrepreneurship and take off from government protection to a more independent and profitable agriculture.

On completion of the crop diversification program in the target area, 14,800 t of traditional and high-value new paddy, 56,000 t of condiments (chilli and big onion), 37,000 t of maize, 31,000 t of

soybean, 2,300 t of grain legumes (green gram and black gram) and 125,000 t of vegetables are added to the total production annually. The development plan suggests three product-based marketing methods as shown in Table 8.5.1. The selection of the recommended marketing methods and target markets is based on four criteria; 1) long-term contribution to the transformation of low-profit agriculture to high profitable agriculture, 2) governmental support is crucial for the implementation, 3) guaranteed buyers, 4) high cost effectiveness.

With provision of irrigation water from NCPC, the off season vegetable cultivation can be promoted. On the other hand, for high value vegetables in particular, the project employs community supported agriculture wherein producers and consumers mutually create a food chain in the region in order to secure market and quality at once. Farmers may freely choose other markets such as supermarkets or other value addition such as processing or off-season sales once the production and selling of those crops are increased with the secured food chain.

Basically, the project aims to raise the farmers' entrepreneurial skills and to support the farmers in addressing the challenges during the transitional stage.

Selecting, prioritising, and implementing the most appropriate project or a combination of projects to suit the particular farming situation should be made solely by the farmers or CMO/FOs on their own initiative and be responsible for its effective operation.

Table 8.5.1 Summary of Proposed Marketing Methods

Product	Marketing Method	Target Market/Produce	Advantages/Challenges
(1) High-value vegetables	Community supported agriculture model (or Sansyo-Teikei)	Market Mid to high-end hotels in Anuradhapura area Produce	Advantages : Farmers can secure buyers and higher prices : Farmers can reduce transactional cost by direct selling Challenges : Required quality can be higher
(2) Other Field Crops (maize, soybean, legumes, condiments)	Contract farming	Market Agribusiness enterprises	Advantages : Higher price is secured in advance : Technical assistance is provided by the companies Challenges : Conflicts from breach of contract by either party.
(3) Traditional Rice	Direct transaction with urban consumers	Market Health conscious consumers in Colombo	Advantages :2-3 times higher price than modern varieties : Easily applicable for rice farmers Challenges : Production may decrease : Market is distanced from the NCPC area

Source: JICA Project Team

8.5.1 PM-1 Establishment of the Community Supported Agriculture Model of High-value Vegetables in Partnership with the Hotel Industry

Main Implementing Agency: PDOA

Project Period: Five years

Target Group: CMO

Project Purpose: Profitable business model of high-value vegetables and fruits in partnership with the hotel industry is established in the NCPC target area.

Project Contents:

The target area of NCPC has a great potential for high-value vegetables and fruits. This is because most target cascades are located in the vicinity or close to the "Cultural triangle of Sri Lanka", *Anuradhapura-Kandy-Polonnaruwa*.

The hotel industry in the "triangle", from middle range to high-end resorts, is well developed. Moreover, most of these hotels seek stable suppliers and prefer to purchase crop requirements directly from farmers. These high-end buyers are willing to pay a premium price which is 30%-70% more than the operating market prices for vegetables and fruits provided that the produce meets the required quality standards. Production of high-value crops offers an opportunity for small-scale farmers and even old aged farmers who wish to optimise the use of farm resources and thereby enhance their farm income.

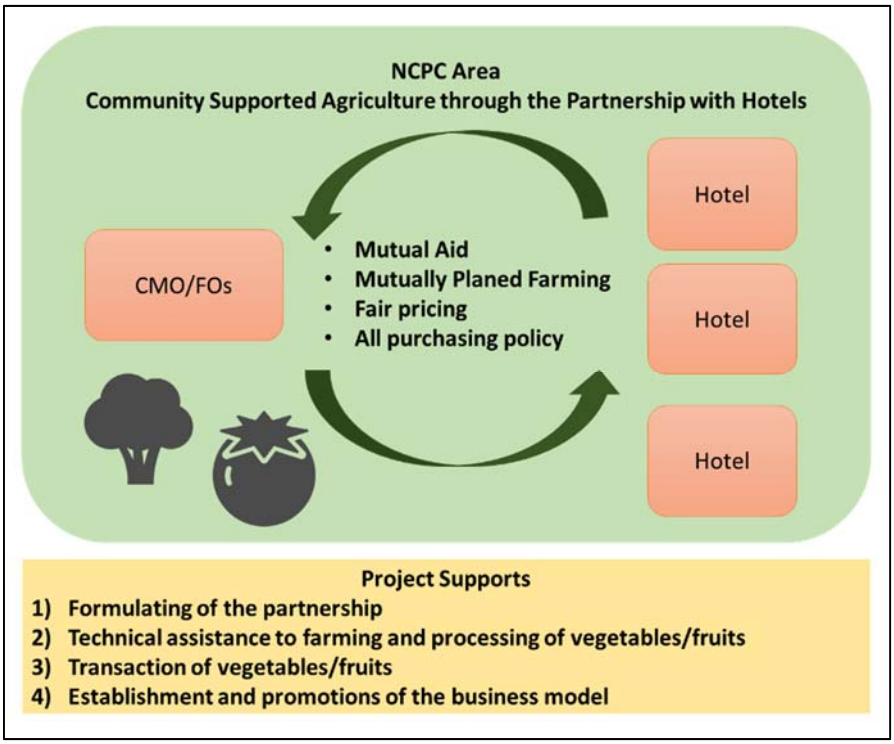
Based on the status quo, the project employs a concept of community supported agriculture (CSA). CSA is a food system that connects producer and consumers more closely by allowing both of parties to engage in farming and processing the produce in a certain farm or a group of farms. It is an alternative socioeconomic model of agriculture and food distribution where both parties share the risks of farming. CSA is rooted in *Sansyo-Teikei* (producers-consumers partnership*)* movement in the 1970s in Japan, where producers and consumers link up directly in order to ensure secure food quality and fair pricing. The NCPC area, being one of the key tourist attractions in the country, is able to develop its own CSA model where FOs/CMOs and hotels mutually engage in planning, farming, producing, quality control, pricing, and so on. The CAS model ultimately aims to enhance the locally supported food system which assures good quality produce required by hoteliers and likewise better marketing for farmers.

To do so, the project coordinates the partnership, and supports the quality control of products and outbound logistics.

In addition, the project provides technical assistance to farming and processing of vegetables and fruits. In the verification program of crop diversification, the project identified several high value crops, such as cauliflower and beets, that are well adaptable in the target area. The project supports to design the most suitable cropping pattern in target areas, utilizing the result.

At the end of the project, the NCPC version of CSA model will be promoted. Notably, farmers freely expand their market channels such supermarkets or develop other value addition such as processing or off-season once the production and selling of those crops are increased through the project.

.



Source: JICA Project Team

Figure 8.5.1 Concept of Community Supported Agriculture

8.5.2 PM-2 Promotion of Contract Farming of Other Field Crops

Main Implementing Agency: PDOA

Project Period: Three years

Target Group: CMO

Project Purpose: The contract farming of OFCs is promoted in the target area through establishment of the official service.

Project Contents:

Sri Lanka imports a large quantity of OFCs despite the fact that the majority of these crops are essential food items in the country and can be locally produced. Thus, there is an urgent need to increase the domestic production of OFCs in order to save valuable foreign exchange spent on imports and to fortify national food security. Responding to the demand in domestic production of OFCs, some major agribusiness enterprises practice contract farming of maize and soya in the target area. Contract farming benefits the participant farmers as it provides a higher produce price and a package of technical assistance. However, there are risks of non-fulfilments or breach of contract. The disputes are mainly caused by the failure to meet the contracted quality/quantity of produce, or by the lack of an authorised regulator. To overcome challenges and promote contract farming, this project aims to establish a one stop governmental body which provides:

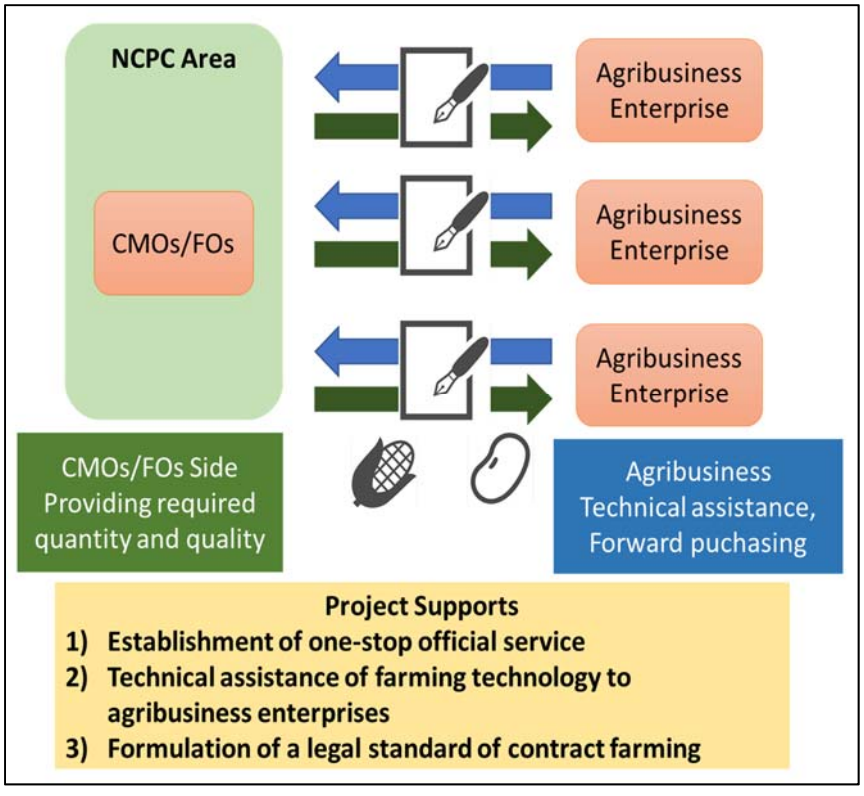
(i) Counselling service between producers and entrepreneurs;

(ii) Coordination of financial loans and agricultural insurance, mediatory;

(iii) Consultation for contract related disputes; and

(iv) Technical transformation of agribusiness enterprises.

The project, in particular, will look into enhancing incentives for agribusiness enterprises to pro-actively engage with local farmers, playing a lead role in the market development. Moreover, the project will formulate capacity-building activities for agribusiness enterprises that will assist them in their role as market leaders. As such, the technical assistance of the activity (iv) will be provided to the target agribusiness enterprises. In addition, the project plans to formulate a formal standardised contract document which will include a warranty for violation and non-fulfilments of contracts.



Source: JICA Project Team

Figure 8.5.2 Concept of Contract Farming of OFC

8.5.3 PM-3 Creation of the Value Chain of Traditional Rice Varieties

Main Implementing Agency: PDOA (Technical assistance for farming), DAD

Project Period: Three years

Target Group: CMO

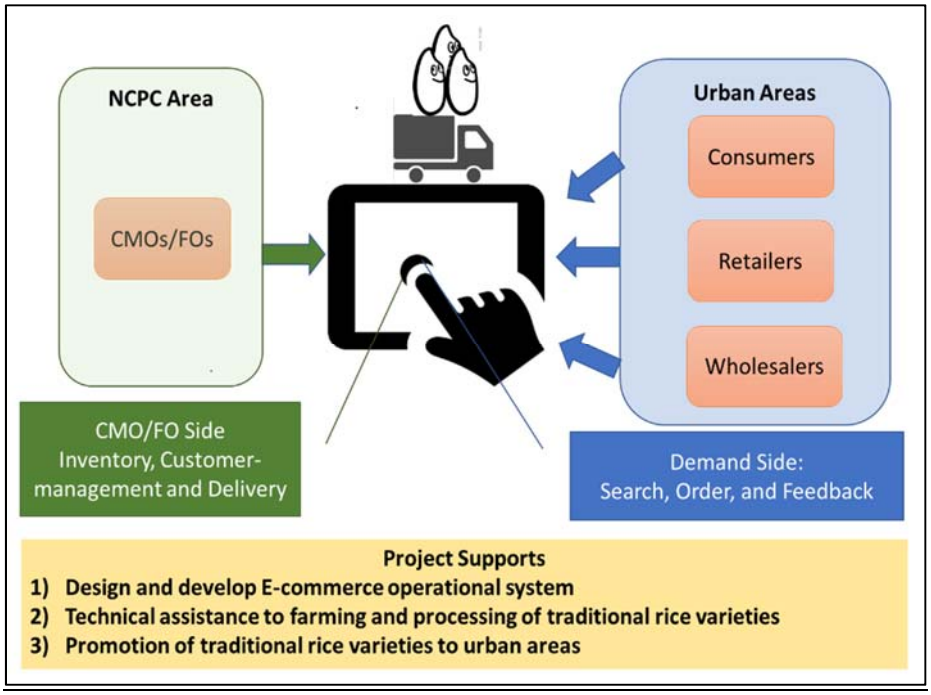
Project Purpose: The cultivation and selling of high-value traditional rice varieties are increased in the target area.

Project Contents:

This project promotes the high-value traditional rice varieties which conventional rice farmers in the target can apply relatively easily. Currently, most of rice farmers in the NCPC sell their paddy to the Paddy Marketing Board (PMB) or millers as they have no other well-defined marketing channels. The government owned PMB often reaches capacity level in paddy purchasing and storage during the harvesting period. This has compelled them to limit the quantity of paddy purchased from each farmer. In order to explore new market channels, the project introduces direct selling and encourages target groups to systematize and record their transactions either through electronic commerce (E-commerce) or other simple methods that connects producers in the target area to the downstream stakeholders in Colombo. For instance, using E-commerce can reduce transaction cost by shortening the supply chain and digitalize each process from inventory management to delivery. Through a website or by a simple tablet/smartphone application, CMOs/FOs are able to manage the inventory of paddy/rice, orders, and deliveries. Consumers, on the other hand, can easily place their orders for traditional rice varieties by accessing different interfaces of the same website or application. Other methods for direct selling may also be considered such as transactions via telephone or short-message service (SMS) accompanied by manual record keeping.

The project supports to design and develop the most applicable direct selling for the target groups. For instance, at the initial stage, the target groups establish a direct selling network with supermarkets or retailers and transact traditional rice to them through phone or other simple methods. Once they secure a sufficient number of direct customers, they are able to choose the most suitable and feasible system such as short message service, to sophisticated, high-technological system.

In addition, the project plans to provide technical assistance in farming and processing of traditional rice varieties to CMOs/FOs. Finally, the project promotes a business model that sells traditional rice varieties directly to consumption areas.



Source: JICA Project Team

Figure 8.5.3 Concept of E-Commerce

8.6 Proposed Projects for Livestock Development

To achieve the production target of milk, the plan proposes three projects, namely; (1) stable feed production and delivery through entrepreneur development, (2) enhancement of livestock management extension system and (3) creating additional value on milk through empowerment of women's groups.

8.6.1 LS-1 Stable Feed Production and Delivery through Entrepreneur Development

Main Implementing Agency: PDAPH and Private Sector

Project Period: Five years

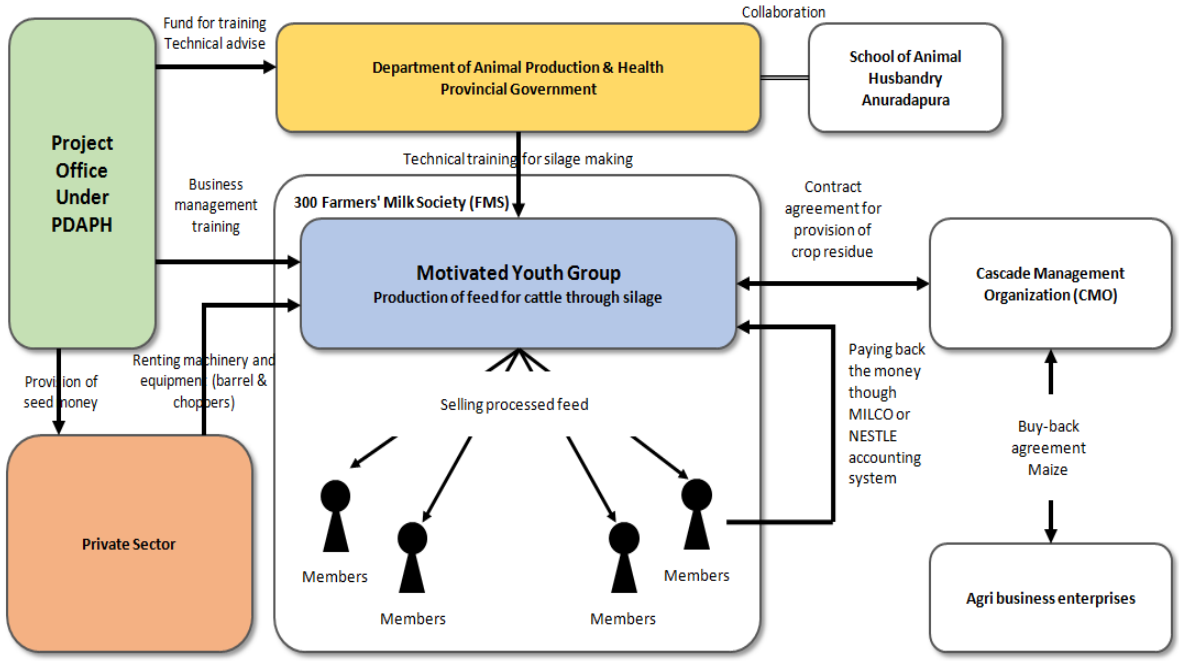
Target Group: Young livestock farmers group in Farmer Milk Societies (FMS)

Project Purpose: Produce and deliver necessary amount of feed to livestock farmers

Project Contents:

This Project expects to establish a system of entrepreneur development, involving motivated young livestock farmer groups in the Farmer Milk Societies (FMS) that collect and process the maize crop residue. In addition, the group would foster the sale of cattle feed to the member of FMS. The FMS is basically a strong organisation functioning with basic accounting and management procedures in milk related service activities.. The sale channels are easily created in the FMS and present accounting systems are also used for transactions on business activities.

Since the cascade managed organisation (CMO) is expected to have the contract farming agreement with agribusiness enterprises on the large-scale cultivation of maize or other field crops as proposed in the crop marketing plan, the project will facilitate to make the contract with the young livestock farmers' group with CMO for purchasing maize or other crop residues at first. Then the project will support the young livestock farmers' group with three channels for their technical, management, and financial capacity development as shown in Figure 8.6.1.



Source: JICA Project Team

Figure 8.6.1 Schematic Drawing on Stable Feed Production and Delivery through Entrepreneurship Development

The first supporting channel is through the Provincial Department of Animal Production and Health (PDAPH). The PDAPH will be in charge of providing the technical training for silage making and maintenance. The project will provide the technical advice as well as funding for training and field demonstration to PDAPH whilst PDAPH will conduct the necessary training programmes to young livestock farmers' group with their human resources. The main training components are (1) economic value of crop residue, (2) basic processing of crop residue including equipment and machinery

utilisation, storage and packaging, and (3) improving nutritive quality of crop residue and those are necessary skills for silage production and maintenance. The second channel is the private sector, such as development banks, major milk industrial companies or agribusiness enterprises who are expected to give the initial fund or equipment to young livestock farmer groups. The project will provide seed money to the private sectors with an agreement, then the private company will provide initial fund or equipment such as choppers or barrels for loan or rental basis. The condition to provide those facilities to young livestock farmer groups is decided based on the terms and conditions agreed between the project and the private sector.

The training on management skills development to young livestock farmer groups is provided by the consultant or resources person hired by the project. The first training program namely "introduction to entrepreneurship development" will provide necessary knowledge and skills on how to establish, manage, and oversee a small-scale business successfully. The content of the program will cover the understanding of basic entrepreneurship, successful business ventures, resource analysis and management, production cycle, costing pricing and profit, market analysis and preparation of a business plan. The second training program, namely, "management skill development' will provide necessary knowledge and skills to improve management capacity. The program will also cover the topic of record keeping, financial management, time management, manpower management, and quality management. The third training program, namely, "business promotion and productivity improvement' will provide required knowledge and skills to promote existing businesses and improve productivity. The content of the program will cover customer relations, value addition, marketing, and production cycle management. In addition to the three main training programs, on-the-job-training will be provided depending on the need.

The project will target nearly 100 young livestock farmers groups for five years and will be implemented with three batches targeting 30, 30 and 40 groups, respectively.

8.6.2 LS-2 Enhancement of Livestock Management Extension System

Main Implementing Agency: PDAPH and Private Sector

Project Period: Five years

Target Group: Livestock farmers in FMS

Project Purpose: Sustain the increment of milk production although livestock management improvement such as breeding and pest and disease control

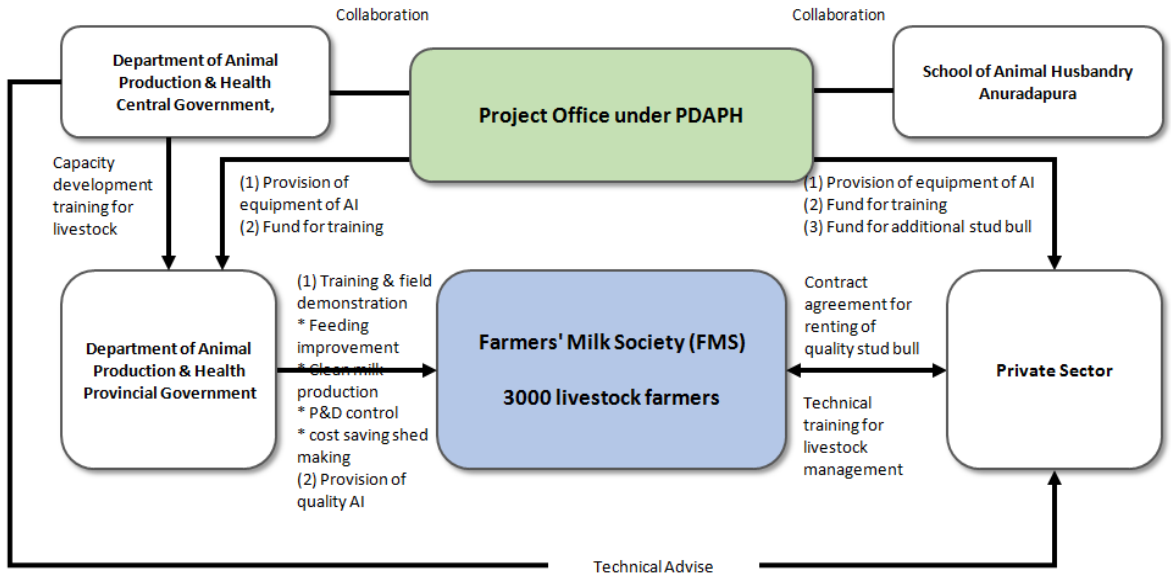
Project Contents:

The availability of feeds by the supply of silage to the farmers of the FMS will encourage the adoption of labour-intensive technology of stall-feeding. However, there are other factors to be considered such as improved management, efficient breeding system, mechanisation, and proper health management. These factors will further encourage farmers to adopt stall-feeding as they will increase the production and productivity of dairy farming. The farmers ultimately decide on the farming system on whether or not to adopt technologies and how to assign resources to support it. The decision to use the technologies proposed is dependent on how the farmers perceive technology. Project activities should provide positive signals to convince the farmers making this decision to adopt the new technology. Hence, the following program is developed to establish the stall-feeding system in the cascade system dairy management.

The Department of Animal Production and Health, Peradeniya will undertake the capacity building activity for the extension staff of the PDAPH and MILCO. The extension staff of these three organisations will then take on farmer training programs at the provincial level. Farmer training activities can be conducted at the School of Animal Husbandry at Sippukulama (SAHS). The major public sector operators supporting this sector, the Provincial Department of Animal Production and Health (PDAPH) and MILCO should work together in providing services, training, and marketing activities. The training modules should include all aspects of dairy management, clean milk production, animal health, record keeping and business management.

Stall-feeding can be based on either zero grazing or semi zero grazing. In the first situation animals are fed silage and concentrates but confined in cattle sheds. In the second aspect when grazing land is available especially during the *Yala* season farmers can allow free grazing or tethered grazing. Hence,

a well-constructed cattle shed should be available to keep the full herd within the facility. This will protect calves from rain and allow them to grow faster than in the open system. This will increase the supply of replacement stock to meet the current demand. Seed money for this facility will have to be provided by the project. This activity will have to be handled by MILCO under the supervision and monitoring of PDAPH. Keeping cattle indoors prevents natural breeding that would cause a high demand for artificial insemination (AI), but the service providers may not be able to cope up with this situation. Hence, strengthening the Artificial Insemination (AI) activities by training and providing equipment to a set of new artificial inseminators is considered. In addition to AI, the project should support natural mating facilities within the FMSs. Both MILCO should handle this activity under the supervision and monitoring of PDAPH. PDAPH and MILCO both should develop stud bull-rearing facilities. Good quality stud bulls could be obtained from the National Livestock Development Board farms. The Faculty of Veterinary Medicine and Animal Science, Peradeniya can undertake training of Veterinary Surgeons (VSs) in this aspect. The early diagnosis of pregnancy and sex determination of the fetus is another aspect supported by the project to increase the number of female calves born. Some of VS have been trained in this subject and the technologies should be disseminated through trained VS to other frontline officers. The male fetus found through diagnosis will be terminated by VS. This will increase the number of replacement stock and will reduce the price per calf, allowing new farmers to take up dairy farming. In farmer focus group meetings with crop farmers this issue was a main point of discussion. It was also found that these farmers are maize growers, and were interested in keeping cattle confined in the stall-feeding system.



Source: JICA Project Team

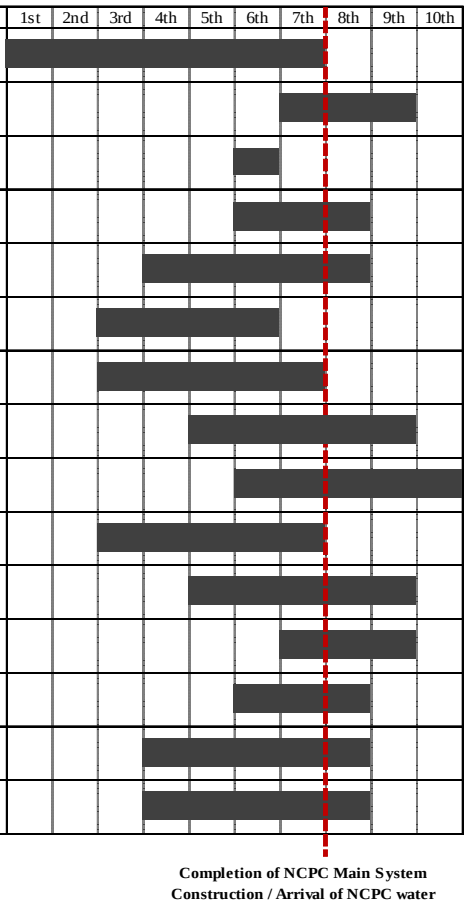
Figure 8.6.2 Schematic Drawing on Enhancement of Livestock Management Extension System

The project is targeting extension officers such as veterinary surgeons and livestock development officers in the government and private sector to uplift the service level for better management of the livestock in this area. The project will be carried out for five years. The project will improve the extension manuals which is available at present based on the pilot activities in the field.

8.7 Overall Project Plan and Implementation Schedule

Figure 8.7.1 shows the overall implementation plan for the proposed 15 projects with conditions that the arrival of the NCPC water will be carried out at the end of the 7th year. The priority of each project also given in the same figure.

Category	No.	Name of Project	Priority
Infrastructure Development	IF-1	Cascade System Facility Development Project	A
	IF-2	Promote Public Awareness Campaign for "Tank Day"	B
Institutional Development	IN-1	Establishment of management structure of NCPC system	A
	IN-2	Establishment of Sub-watershed level management system	A
	IN-3	Establishment of Cascade Management Organisation	A
	IN-4	Improving capacity of FOs in tank level water management	B
Agriculture Development	AG-1	Cultivation Skills Development and Provision of Quality Input to Booster Crop Diversification	A
	AG-2	Promotion of Farm Mechanisation	A
	AG-3	Improvement of Accessibility to the Fund	A
	AG-4	Enhancement of Agriculture Extension System Platform	B
Post-harvest and Marketing Development	PM-1	Establishment of the Community Supported Agriculture Model of High Value Vegetables in Partnership with Hotel Industry	A
	PM-2	Promotion of Contract Farming of Other Field Crops	A
	PM-3	Creation of the Value Chain of Traditional Rice Varieties	B
Livestock Development	LS-1	Stable Feed Production and Delivery through Entrepreneur Development	A
	LS-2	Enhancement of Livestock Management Extension System	B



Note A : High priority B : Moderate priority

Source: JICA Project Team

Figure 8.7.1 Overall Project Implementation Plan

Since "IF-1 Cascade System Facility Development Project" will provide necessary infrastructure to deliver the NCPC water for each tank in the cascade system, it should be completed fully before arrival of NCPC water. Considering the project period required for IF-1, IF-1 should be commenced at 1st year. The IN-4 proposes to start at the same time of completion of construction work of 1st batch of IF-1 since IN-4 aims capacity development of DAD officer for training of FO for water management for tank irrigation system.

Although the project for post harvest and marketing and production proposed separately, those should be implemented together as a crop diversification programme. In order to root and expand transferred technologies to the famers in target area, the cultivation skills development of AG-1 should also start early in 3rd year together with AG-4. Especially AG-1 targets cultivation skills development as well as marketable crop planning for profitable agriculture. The achievement of AG-1 will contribute to the other projects implemented after.

AG-2 and LS-1 together with LS-2 includes key actions to achieve the profitable agriculture in the cascade systems. Those project should start in 5th year and continue till 9th year covering at least two cultivation season after arrival of NCPC water.

IN-3 should start in 4th year together with construction of link and tertiary canal till 8th year covering two cultivation season after arrival of NCPC water. PM-1 to 3 project will commence before two or three years before starting the actual cultivation in the field and continue till 9th year in general Two years before completion of NCPCP, IN-1 & 2 will commence to establish and develop the capacity of the necessary system for main and branch canal level water management.

IF-2 and AG-3 mainly focus on activities after arrival of NCPC water to the area. For the preparation of the project, both should start in 6th or 7th year.

Chapter 9 Environmental and Social Considerations

9.1 Background Information Related to Environmental and Social Considerations

This section describes key information including relevant organisations, legislation and policies concerning environmental and social considerations as well as the current condition in the project areas.

9.1.1 National and Regional Government Organisations

(1) Organisations for Environmental Protection

The Ministry of Mahaweli Development and Environment (MMDE) is Sri Lanka's most relevant entity with regard to environmental considerations. The MMDE is responsible for the management of the environment and natural resources of the country, "providing leadership in order to ensure national commitment for sustainable development for the benefit of the present and future generations"[1].

There are ten implementing agencies under the jurisdiction of the MMDE, namely: Central Engineering Consultancy Bureau, Central Environmental Authority, Coast Conservation and Coastal Resource Management Department, Forest Department, Gem and Jewellery Research and Training Institute, Geological Survey and Mines Bureau, Mahaweli Authority of Sri Lanka, Marine Environment Protection Authority, National Gem and Jewellery Authority, and State Timber Corporation. Amongst them, the Central Environment Agency (CEA) plays the central role for environmental protection, management, and enhancement.

The CEA operates in the provincial, regional and sub-regional offices which handles most compliance and enforcement functions. It also has a District Environmental Agency in each district that operates under the Government Agent (GA).

At the provincial and district level, the Provincial Councils have power to make statutes applicable within the province in respect of the subject areas specified under the Constitution. For example, the North Western Province has set up statutes for environmental protection on its own in 1990. Other local authorities like Municipal Councils, Urban Councils and *Pradeshiya Sabhas* also have power to formulate subsidiary legislation.

(2) Organisations for Environmental Conservation

There are two major government organisations that undertake environmental conservation in Sri Lanka. The Department of Wildlife Conservation (DWC), a non-ministerial government department, is responsible for the protection of wildlife resources throughout the entire country. DWC also has the legal authority to establish and manage the network of the Wildlife Protected Areas (WLPAs), national parks, nature reserves and wildlife of wilderness areas in Sri Lanka. It falls within the purview of the Ministry of Wildlife Resources Conservation. The Forest Department is another entity whose role is to maintain forest reserves and wilderness areas. More than half (55%) of the forest and wildlife in Sri Lanka is managed and protected by the Forest Department, whilst the rest falls under the DWC's purview. It is also a non-ministerial government department.

9.1.2 Important Legislation and Policies Concerning Environmental and Social Considerations

National policies and important legislation concerning environmental and social considerations are summarised in Table 9.1.1 and Table 9.1.2 below.

[1] MMDE website

Table 9.1.1 Key Legislation Concerning Environmental and Social Considerations

Legislations	Contents
National Environmental Act (NEA), No.47 of 1980, and Amendments in Act No. 56 of 1988, Act No.53 of 2000	The NEA is the umbrella environmental protection legislation. It provides an environmental framework for protection, management, and enhancement of the environment.
Forest Ordinance No.6 of 1907 and amended up to 2009	The law for conservation, protection, and management of forests and forest resources.
Fauna and Flora Protection Ordinance No.02 of 1937, amended 2009	The act provides protection and conservation of the fauna and flora of Sri Lanka and their habitats. This act specifies that any development activity that takes place within the one mile of the boundary of a National Reserve declared under the Ordinance require an Environmental Impact Assessment (EIA) / Initial Environmental Examination (IEE).
Mines and Minerals Act 1973	All resources required for construction must be procured from quarries or burrow sites having a valid mining license.
Felling of Trees Control Act No. 9 of 1951 and amended through Act No. 30 of 1953	It prescribes the permissions from the Divisional Secretary in case some trees have to be removed.
National Water Supply and Drainage Board Law No.2 of 1974	The act deals with the prevention of pollution of rivers, streams, and other water sources and regulates the supply and distribution of safe drinking water.
Irrigation Ordinance No. 32 of 1946	The ordinance deals with environmental aspects of water and land use in irrigation agriculture.
Paddy Lands Act of 1958	The Department of Agrarian Services was established in order to encourage farmer's participation in minor irrigation development. Cultivation Committees were also established under this act.
Agriculture Productivity Law of 1972	Responsibility of minor irrigation development was transferred back to the Irrigation Department. Agricultural Productivity Committees (APC's) were established for the development of irrigated agriculture.
Agrarian Development Act No. 46, 2000	The act provided for, matters relating to landlords and tenant cultivators of paddy lands, for the utilisation of agricultural lands; for the establishment of agrarian development councils, for the establishment of a land bank.
Agrarian Services Act No. 59 of 1991	Farmers' organisations (FO's) were given legal authority to undertake irrigation contracts under this act.
National Aquatic Resources Research and Development Agency Act 1981	The act addresses the management, regulation, conservation, and development of fisheries and aquatic resources.
Control of Pesticide Act No.33 of 1980 and Amendments	It provides for the licensing of pesticides; to regulate the import, packing, labelling, storage, formulation, transport, sale, use, etc.
Soil Conservation Act No.25 of 1951 and Amendments	It was designed to conserve soil resources, mitigate soil erosion, and protect land against damage by floods and droughts.
Plant Protection Ordinance No.35 of 1999	The Ordinance makes better provision against the spread of weeds, pests, and diseases injurious to, or destruction of, plants, and foe the sanitation of plants.
National Heritage Wilderness Act No.3 of 1988	Identifying and protecting important wilderness areas in the country.
Land Acquisition Act, No. 9 of 1950 and 1956	It makes provision for the acquisition of lands and servitudes for public purposes.
Crown Lands (State Land) Ordinance No.8 of 1947 and Amendments	This ordinance deals with the power of the state to sell, lease, grant or otherwise dispose state lands for management and control.
Land Development (Amendment) Act, No. 9 (1995), No.20 of 1996	The act provides for the systematic development and alienation of state land in Sri Lanka.
Land Settlement Ordinance No. 20 of 1931	An ordinance to amend and consolidate the law relating to land settlement.

Source: Prepared by the JICA Study Team from various documents and webpage.

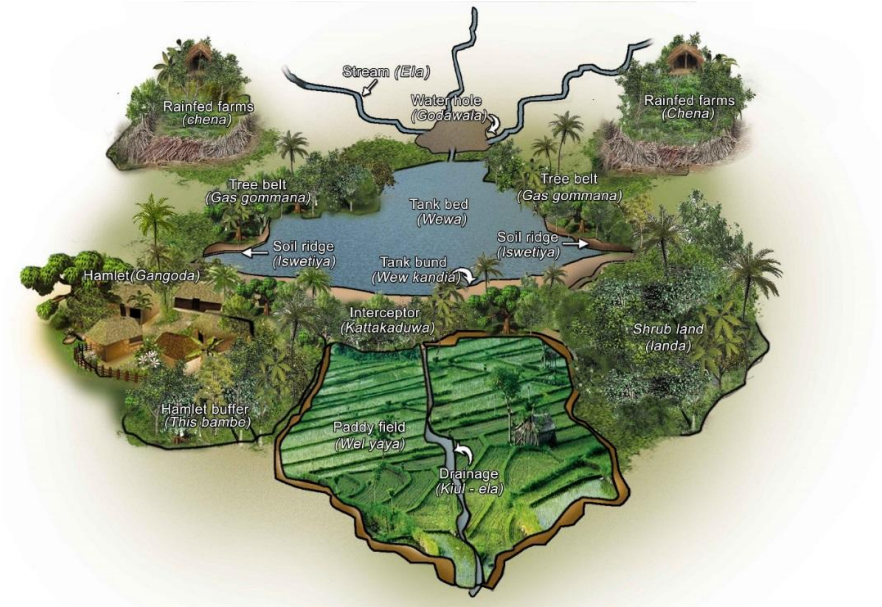
Table 9.1.2 Major Environment and Resettlement Policies

Policies	Contents
National Environment Policy - 2003	It aims to promote the sound management of environment balancing social and economic development and environment integrity, assuring environmental accountability.
National Forestry Policy - 1995	The objective is to provide clear directions for safeguarding the remaining natural forests in order to conserve biodiversity, soil, and water resources.
The National Policy on Wildlife Conservation - 2000	It shows the government commitment to conserve wildlife resources through promoting conservation, maintaining ecological processes and life sustaining systems, managing genetic diversity, and ensuring sustainable utilisation of biodiversity.
National Watershed Management Policy - 2004	Policy aims to conserve, protect, rehabilitate, sustainable use and manage the watersheds, managing their environmental characteristics.
Cleaner Production Policy - 2004	It tries to incorporate the cleaner production concept and practices into all development sectors of the country.
National Biosafety Policy - 2005	It sets the overall framework for developing and practicing adequate safety measures in order to minimise possible risks to human health and the environment.
National Air Quality Management Policy - 2000	It aims to maintain good air quality to reduce morbidity due to air pollution and in turn reduce national health expenditures.
National Policy on Wetlands – 2005	It identifies the National Wetlands and gives effect on National Environment Policy and other relevant national policies.
National Policy on Sand as a Resource for the Construction Industry - 2006	It defines the commitment of government to effectively manage the construction-sand resource for the benefit of present and future generations.
National Policy on Elephant Conservation - 2006	The policy was developed to ensure the long-term survival of the elephant in the wild in Sri Lanka through the mitigation of the human-elephant conflict.
National Policy on Solid Waste Management	It aims to ensure integrated, economically feasible and environmentally sound solid waste management practices at national, provincial and Local Authority level.
National Involuntary Resettlement Policies (NIRP) of 2001 and Amendment in 2009	It addresses resettlement issues. The NIRP requires comprehensive plans to be prepared when 20 or more families are affected.

Source: Prepared by the JICA Study Team based on various sources, including Profile on Environmental and Social Considerations in Sri Lanka, JICA (2012) and http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan042380.pdf.

9.1.3 Environmental and Social Conditions in the Project Area

(a) Landscape and Ecosystem of Cascade System



Source: Presentation material on Cascade Irrigation Systems for Rural Sustainability held on 9th December 2010 at SLFI, Colombo, P.B. Dharmasena

Figure 9.1.1 Village Tank System in the Dry Zone of Sri Lanka

The current cascade systems in the project area were created in the ancient times and were designed to best utilise rain water. There are more than 15,000 small tanks spread in the Northern Central Dry Zone of Sri Lanka. They are not randomly located and distributed: they are located in the form of distinct cascade that are positioned within the small watersheds. A cascade is made up with 4 to 10 of individual small tanks[2].
Figure 9.1.1 above shows a typical village tank system in a dry area of Sri Lanka. A tank, paddy fields, watershed, canals, and village are integrated as they blend into the natural environment, forming a unique ecosystem. The forest ("Mukalana") located upstream of the irrigation tank is jointly owned by the village, and it is preserved strictly by controlling logging of trees and expansion of agricultural land. Since ancient times, only non-timber forest products such as medicinal herbs for Ayurveda have been sustainably utilised. However, the most important role of "Mukalana" was to purify the rainwater and to raise the groundwater level by gradually releasing the water during the dry season to the irrigation tank. Rain water is caught in "Mulakana" and "Chena" land flows into "Godawala". It is a small tank that traps sediment flow into the tank and provides water to animals. Then, water flows into the tank. There is a forest called "Gasgommana" in the immediate upstream area of the irrigation tank. It plays a role of regulating the amount of water by absorbing when water level is high, preventing strong wind, lowering temperature and a buffer zone between wild animals and humans. Large trees are observed and it is a habitat for various fish. Just below the tank bund (outside), a zone with various vegetation called "Kattakaduwa" is preserved. This has a role of preventing salt and ferric ions from entering paddy fields. Farmers have used this part by planting various trees for the various purposes, including for fuel, medicine, home and agricultural tools, food, etc. Each part in the village tank system has its own unique function to effectively maintain and utilise rain water as well as serves as a habitat for diverse flora and fauna, migratory birds and sustainable human activities, which has a great contribution to preserve biodiversity.

(b) Protected and Sensitive Areas

In Sri Lanka, environmentally protected and sensitive areas are identified in part 111 of the schedule of the Gazette Extra Ordinary No. 772/22 of 24th June 1993 and subsequent amendments (EIA regulations). These areas include; 61 sanctuaries, 3 strict nature reserves, 7 nature reserves, 26 national parks and one elephant corridor. None of these listed areas falls into the project area.

(c) Forest Reserves

There are several forest reserves and proposed forest reserves in the project area both in Anuradhapura and Vavuniya districts. However, disturbance of these forest reserves is not likely to occur by the project: The construction will take place only inside the developed area, and rehabilitation of the tank systems and establishment of inter-tank channels and small roads involve only limited vegetation clearance.

(d) Wetlands

According to the National Wetland Directory, there are six national wetlands in Anuradhapura District. Amongst these six wetlands, two wetlands, namely: Wahalkada Tank and Padaviya Tank may be affected by the project. Both are located just outside the project area, but water from the cascade systems flow into these two tanks and water quality may be affected, depending on the activities conducted in the upper stream cascade systems. Close monitoring would be required to minimise the impacts to these two wetlands. In Vavuniya District, there are no wetlands listed in the directory.

(e) Cultural Heritage and Archaeological Sites

Sri Lanka has six archaeological UNESCO World Heritage Sites, but none of these overlap with the project sites. However, many other archaeological sites are scattered throughout Anuradhapura District, and there are many in the project areas. Protection of these sites falls under the responsibility of the Department of Archaeology. Although the project has no plans to affect these sites, special attention or respect should be heeded not to harm these sites.

[2] Kapila Peiris, "Ecosystem based Indigenous Water Management", National Science Foundation, 2008

Table 9.1.3 Archaeological Sites in Vavuniya and Anuradhapura Districts

No.	Map No.	Site Name	No.	Map No.	Sites Name
Vavuniya District					
1	1	Unknown	2	2	Unknown
Anuradhapura District					
1	6	Isebessagama	13	110	Pahala Divulwewa
2	8	Palippothana	14	114	Thammennewa
3	12	Kedewa	15	115	Ethalvidda Wewa
4	13	Kirigalwewa	16	117	Puhulwewa
5	14	Diviyaudabendawewa	17	121	Kurukuragama
6	16	Kuda Vilachchiya	18	122	Dachchihalmillewa
7	17	Ethdathkalla	19	124	Kalpe
8	48	Ranpathwila	20	127	Medawachchiya Junction
9	49	Kokmaduwa	21	130	Panwella
10	50	Upuldeniya	22	131	Mahawewa
11	51	Konwewa	23	132	Konwewa
12	52	Himbutugollewa	24	136	Ihalagama

Source: Prepared by the JICA Study Team based on the Environmental Sensitive Areas Maps by CEA

(f) Flora, Fauna and Biodiversity

The project target areas are biologically categorised as the "Low Country Dry Zone", and typical Dry Zone flora and fauna as well as many endemic species are found in this area. Areas around the minor tanks, especially downstream farming areas, are already heavily influenced by agricultural activities, whilst forest areas in the catchment areas remain as the typical dry zone vegetation systems.

Sri Lanka's threatened biological species are found in the "*The National Red List 2012 of Sri Lanka: Conservation Status of the Fauna and Flora".* The numbers of threatened species existing in Anuradhapura and Vavuniya districts are shown in Table 9.1.4[3].

Table 9.1.4 Distribution of Threatened Species in Anuradhapura and Vavuniya Districts

	Freshwater Fish			Amphibians			Reptiles		
	CR*	**EN****	**VU*****	**CR**	**EN**	**VU**	**CR**	**EN**	**VU**
Anuradhapura	1 (1)*****	3 (2)	4 (3)	0	0	3 (2)	2 (2)	5 (3)	8 (3)
Vavuniya	1 (1)	1 (0)	0	0	0	0	0	0	1 (0)
	Birds			**Mammals**			**Total**		
	CR	**EN**	**VU**	**CR**	**EN**	**VU**			
Anuradhapura	0	1 (0)	6 (0)	0	12 (1)	12 (1)	57 (18)		
Vavuniya	0	3 (1)	5 (2)	0	0	0	11 (3)		
	Flora								
	Total Species		**Threatened Species**		**Endemic Species**		**Threatened Endemic Species**		
Anuradhapura	956		236		100		47		
Vavuniya	218		41		9		5		

*Note: * CR: Critically Endangered, **EN: Endangered, ***VU: Vulnerable, ****the numbers inside the parentheses indicate endemic species.*
Source: The National Red List 2012 of Sri Lanka: Conservation Status of the Fauna and Flora, GOSL

These flora and fauna may be affected by the project. According to a study conducted at Kapiriggama[4] Cascade System in Anuradhapura District by IUCN in 2015, nine endemic species, three endangered species and 22 vulnerable species of flora as well as three endangered species, five vulnerable species and 12 near threatened species of fauna were found in this cascade area[5]. It is presumed that similar numbers and kinds of those threatened species could be found in the cascade systems of the project areas as both areas belong to the same biological zone.

[3] It should be noted that the numbers are not necessarily definite, especially in Vavuniya District.
[4] Kappiriggama Cascade System is located over three GNs, namely: Kapiriggama GN, Konakumbukwewa GN, and Penagama GN in Anuradhapura District.
[5] *"Biodiversity and Ethnobiology"*, IUCN Cascade Development Project Information Brief No. 2, December 2015, IUCN

(g) Current Situation of Other Natural, Social and Economic Environment in the Project Area

The current situation of the natural environment such as weather, soil/geology, hydrology, water use, land use, as well as social and economic environment such as demography, agriculture, economy, institutions and organisations, and gender is summarised in Chapter 3 and Chapter 6 of this report.

9.2 Anticipated Impacts on Environment and Society by the Proposed Cascade System Development Plan

The proposed Cascade System Development Plan (hereinafter called the Development Plan) is to be implemented under the North Central Province Canal Project (NCPCP), and the impacts on the environment and society exerted by the implementation of the Development Plan itself are to be evaluated and compared with the situation at the point of completion of the NCPCP which shall be regarded as the "before-the-project" situation.

However, it is difficult to separate the impacts to be brought about by the NCPCP from the implementation of the Development Plan in some issues. Moreover, there are matters under consideration related to NCPCP at the time of writing this report, such as the location and length of the tertiary canals and division points from the branch canal, and the amount of water to be provided to each cascade, which makes estimating impacts of the Development Plan difficult. Considering these factors in the section below, first, the impacts by the NCPCP are discussed, followed by a consideration of the anticipated impacts of the Development Plan.

9.2.1 Environmental and Social Impacts of NCPCP

NCPCP is implemented by the Government of Sri Lanka with the financial assistance of Asian Development Bank (ADB). It aims to improve agricultural productivity and economic situation in the north-central dry zone by constructing the water canals and drawing water from the Moragahakanda Reservoir to the northern central and northern states via the Fululu wewa Reservoir, transferring water to the existing 128 cascade systems in the target area. According to the ADB analysis, it is estimated that smaller tanks will receive about 130 ha/MCM in the *Mah*a season and 100 ha/MCM in the *Yala* season, major tanks receive about 120 ha/MCM during the *Maha* season and 90 ha/MCM during the *Yala* season, and as a whole, 1020 MCMs will be supplied in average (please refer to Chapter 4 for the details).
NCPCP includes constructing up to 89 km of a main canal and 182 km of branch canals. It also involves land acquisition and resettlement. In addition to the large-scale construction, the fact that large volume of water by NCP will be poured all year-around into the cascade systems, which were only used for rainwater, is making the stakeholders worry about adverse impacts on the environment and society in the target area. The following table summarises some of those concerns.

Table 9.2.1 Potential Environmental and Social Concerns Related to NCPCP

Aspects	Concerns
Impacts on biodiversity	There are opinions that worry about negative impacts caused by NCP water to the eco-system in the cascade system. They say that ecological balance will be lost and biodiversity will collapse by increasing the absolute amount of water flowing into the cascade system (or by having more water even in Yala season). In addition, NCP water originates from the Mahaweli basin where water is contaminated by agro-chemicals used in the up-country, and the purity of water in the cascade in the area will be lowered. On the other hand, there is also a view that the water circulation of the tanks improves as the amount of water supplied increases throughout the year; BOD and COD will be lowered, water quality may be improved, and it affects the ecosystem rather positively.
Deforestation of upstream forest areas	Some researchers say that there is a risk that incentives to conserve upstream forest areas for effective water collection could further diminish, and topography or landscape in cascade will be changed after the NCP water is drawn to the tanks. As it is, the amount of water supplied by the NCP water supplements traditional rainwater, and it is impossible to secure enough water to achieve the agricultural productivity and economic development without proper collection of rainwater. In addition, the catchment areas including the upstream forests also have the role of filtering the silt flowing into the tank. Failure to preserve the catchment areas will cause sedimentation of silt into the tank and it decreases the water storage capacity and function of the tank. For sustainable development, it is necessary to simultaneously preserve forests around the irrigation tank and conserve the ecosystem.

Salt damage caused by drainage problems	There is a concern on salt damage: NCP water could raise ground water level and cause drainage problem, they say. Generally speaking, water logging could occur and excess water stagnates in the command area to which salts (derived from chemical fertilisers and pesticides) in the soil dissolve, if the irrigation system has no proper drainage system. In the arid zone, capillary rise in the soil and vaporisation of the soil surface are promoted, and salt is accumulated on the soil surface. As a result, capacity of absorbing moisture and nutrients of crops is lowered and productivity will drop significantly.
Change in social capital and traditional cultivation systems	There is a concern on disappearance of Bethma and other traditional cultivation systems by having certain amount of water for cultivation in the *Yala* season. Bethma and other traditional cultivation systems, such as *tattomal* and *kacchimal*, were the measures to survive during the dry season as a whole community as well as mechanisms to retain social capital. Even under the current situation, the number of tanks implementing the Bethma system is decreasing.
Increase of land related issues such as encroachment, fragmentation and conflicts	There is a concern that cultivable land will increase as the groundwater level rises with NCP water and illegal encroachment of paddy field may increase. Also when the price of the land rises, fragmentation of the land as well as conflict over land ownership tends to increase.

Source: Created by the JICA Project Team

(1) Strategic Environmental Assessment (SEA) Study Results of NCPCP by ADB

The environmental and social impacts of NCPCP are planned to be assessed in the EIA which will be prepared as part of the Detailed Design by 2018. At the time of writing this report, the draft SEA of Mahaweli Water Security Investment Programme (MWSIP) is available, in which environmental and social impacts of NCPCP are also discussed. The SEA of MWSIP explains that the main effects of NCPCP will be caused by the changes of land use and river flows in the target area. The study presents the results according to four categories, namely;

- Socio-economic impacts;
- Changes of surface water hydrology and aquatic ecology;
- Impacts on protected areas and elephant conservation areas; and
- Land cover / land use changes.

Table 9.2.2 summarises the result of the analysis: adverse impacts on these four aspects, only a part that is related to the NCPCP.

Table 9.2.2 Summary of Anticipated Adverse Impacts of NCPCP

Aspects	Anticipated Adverse Impacts
Social and Economical	• Acquisition of land and assets, resettlement • Noise, dust, traffic, population influx (workforce) by construction • Increase of water-related diseases • Reduced and rapid changes in-stream flows in certain streams • Possible increased flood risk in some stream section • Deterioration of water quality in irrigation return flows due to the increased use of agri-chemicals caused by increased cropping intensity
Surface Water and Ecology	• Fish migration and sensitive aquatic habitats may be affected by blockage of river by dams and hydrology changes in the Malwathu Oya, Yan Oya, and Pargi Aru rivers • Risk of flooding in the river upstream of Yan Oya Reservoir in 2028 scenario: highest flows would shift to the period of monsoon season, but decreasing the flows from July to October could be a problem for water users • Water quality in Pali Aru Reservoir (for drinking water supply) • Risk of overflow of the river channel, particularly during the monsoon season when heavy rainfalls may yield a lot of runoff water in a short time
Protected Areas	Some impacts on wildlife may be caused by intensified farming and possibly induce spreading other human land uses into the remaining forest in the upper parts of Yan Oya and Ma Oya basins
Land Use	• Economic displacement caused by loss of farm land • Land take impacts during construction and permanently • Conversion of natural habitats by expansion and encroachment of human land uses

Source: Created by the JICA Project Team based on the draft SEA of MWSIP

The draft SEA report explains that "the NCPCP will contribute to reaching socio-economic objectives, such as the maintaining of rice self-sufficiency, provision of income, employment and food security in rural

areas, and to mitigate the aggravating problem of water shortages in the dry parts of the country"[6], but it "will impede the implementation of measures to achieve objectives for biodiversity conservation"[7]. It emphasises the importance of more detailed assessment of impacts on environment, especially on river habitats and elephant population and to take necessary mitigation measures in order to minimise the adverse impacts. In addition, it suggests to create forest reserves to allow elephants to migrate freely in the area for their conservation. It summarises that optimising project designs and improving farming practice can also contribute to mitigate the impacts.

9.2.2 Impacts from the Implementation of the Proposed Development Plan

Given the impacts of NCPCP above (which would constitute the "before-the-project" situation), the impacts of the Development Plan will be discussed here.

(1) Sub-projects in the Proposed Development Plan

A total of 15 sub-projects in five categories were proposed in the Development Plan, as explained in Chapter 8. Table 9.2.3 summarises these 15 sub-projects.

Table 9.2.3 Proposed Sub-projects in Cascade Systems Development Plan

	Development Category	Short Name	Sub-project Name	Content
1	Agricultural Development	AG-1	Promotion of Farm Mechanisation	Promotes changes in the farming management for crop diversification. It provides DOAs and farmers with technical support for synchronisation of the cropping pattern and type of crops in particular area as well as for utilisation of machineries for farming.
		AG-2	Cultivation Skills Development and Provision of Quality Input to Booster Crop Diversification	Provides farmers with skills and high quality inputs for high value crops, OCFs and new varieties production.
		AG-3	Improvement of Accessibility to the Fund	Disburses funds to selected commercial banks functioning in the target area to serve farmers for investments in crop production, acquisition or fabrication of farm machinery and equipment or workshop tools, which is similar to the existing one between the CBSL and the PFIs.
		AG-4	Enhancement of Agriculture Extension System Platform	Establishes a firm agriculture extension system platform to increase the agriculture productivity and production.
2	Post-harvest and Marketing Development	PM-1	Creation of the Value Chain of Traditional Rice Varieties with E-Commerce System	Introduces electronic commerce (E-commerce) that directly connects producers in the target area to the downstream stakeholders in Colombo.
		PM-2	Establishment of the Community Supported Agriculture Model of High Value Vegetables in Partnership with Hotel Industry	Coordinates partnership, and supports the quality control of products and outbound logistics by employing the community supported agriculture.
		PM-3	Promotion of Contract Farming of Other Field Crops	Promotes contract farming of OFCs by establishment of one-stop official services, technical assistance for agribusiness enterprises, formation of regal standard for contract farming, etc.
3	Livestock Development	LS-1	Stable Feed Production and Delivery through Entrepreneur Development	Establishes a system of entrepreneur development for motivated young livestock farmers groups collecting and processing the maize crop residue and selling those as cattle feed to the members.
		LS-2	Enhancement of Livestock Management Extension System	Improves livestock management such as efficient breeding system, mechanisation and proper health management. It expects to involve private sector for better breeding practice.

[6] *Draft SEA of MWSIP, Page 10-4*
[7] *Same as above*

4	Infrastructure Development	IF-1	Cascade System Facility Development Project	Rehabilitates and constructs irrigation and drainage facilities of 128 cascade systems in the project area. The work includes rehabilitation of tanks, sluices and spillways, provision of bathing steps, construction of tertiary and link canals with related concrete structures. Those facilities will enable to conduct proper and efficient water distribution in the project area.
		IF-2	Promote Public Awareness Campaign for "Tank Day"	Promotes stakeholders' awareness for importance of maintenance of irrigation facilities and disaster management by conducting campaigns.
5	Institutional Development	IN-1	Establishment of Management Structure of NCPC System	Establishes an administration structure that coordinates different levels of government management bodies for efficient and effective NCPC water distribution.
		IN-2	Establishment of Sub-watershed Level Management System	Forms Sub-watershed Management Committees (SWMCs) at each sub-watershed area in order to manage water distribution at the NCP branch canals.
		IN-3	Establishment of Cascade Management Organisation (CMO)	Establishes and capacitates CMOs for efficient and effective management of cascade systems and cascade level water distribution.
		IN-4	Improving Capacity of FOs in Tank Level Water Management	Strengthens existing FOs' capacity for better water management.

Source: JICA Project Team

(2) Anticipated Impacts from the Implementation of the Sub-Projects

Based on the proposed activities of the sub-projects, potential impacts on environmental and social issues likely to occur from the implementation of these sub-projects were evaluated. Table 9.2.4 below summarises the impacts on the issues with their ranking according to the environmental criteria of the JICA guidelines. Additional explanation of the impacts and issues generated by the proposed Development Plan follows Table 9.2.4. It is noteworthy that only the sub-project of "Cascade System Facility Development Project (IF-1)" is concerned with the construction phase assessment. The other 14 sub-projects have no constructions involved in the activities.

Impacts were evaluated using the hypothetical situation at the time of completion of the construction of the infrastructure part of the NCPCP (main channel, branch waterway) as "before the project", referring to the information on SEA of MWSIP. Also, this statement DOES NOT take into account the mitigation measures (showing the situation of "without any interventions"), which is suggested in the later part of this chapter.

Table 9.2.4 Impacts of the Proposed Project

Issues	Pha-se	Possible Impacts	JICA Rank-ing
Air Pollution	C	Dust and exhaust gas will be generated by land clearing and excavation works for the construction and rehabilitation of irrigation structures and inter-tank roads. However, impacts will be quite limited because this happens only for a limited time of construction and outside the housing zones. (by IF-1)	D
	O	Exhaust gas from the increased agricultural machineries will be generated. However, impacts will be limited because time and period of usage of these machineries is limited. (by AG-1)	D
Water Pollution	C	Water pollution by contamination of sedimentation to water from excavation work, fuel oils from construction vehicles and cement are expected. However, it is temporary and limited. (by IF-1)	B-
	O	Water pollution by contamination of fuel oils leaking from agricultural machineries will be generated, if machineries are not maintained properly. (by AG-1) Increased usage of agro-chemicals such as fertilisers and pesticides in crop diversification has a risk to cause water pollution. However, the project also tries to instruct proper application of better quality inputs to farmers, which could prevent the pollution. (by AG-2) Increased livestock waste in sheds may become a source of water pollution, if it is not treated properly. (by LS-2)	B-

Waste	C	Various solid waste, mainly green waste, soil excavation waste, demolition /construction waste will be generated. (by IF-1)	B-
	O	Livestock waste from the stable will be increased. (by LS-1)	B-
Soil Contamination	C	There may be contamination of fuel oils from construction vehicles. However, it will be very limited. (by IF-1)	D
	O	Increased usage of the agro-chemicals such as fertilisers and pesticides in diversification farming may cause contamination and accumulation of salt in soil. (by AG-2) Increased livestock waste in sheds may contaminate soil, if it is not treated properly. (by LS-2)	B-/C
Noise and Vibration	C	Noise and vibration by the construction and rehabilitation works may occur. However, impacts will be limited because this happens outside the housing zones. (by IF-1)	D
	O	The slight increase of road traffic in village areas for the transportation of agriculture products may affect noise levels, but it will not be significant. (by AG-1, AG-2)	D
Ground Subsidence	C/O	There is basically no ground subsidence likely to occur.	D
Offensive Odors	C	Exhaust gases from construction vehicles may cause undesirable odor. However, impacts will be quite limited because this happens outside the housing zones. (by IF-1)	D
	O	There is basically no offensive odors likely to occur.	D
Bottom Sediment	C	Dredging of sediment from tank bottom for rehabilitation of tanks could cause the impacts on bottom sediment. However, this is a positive impact, restoring original ecosystem of tanks. (by IF-1)	B+
	O	If tanks are filled with water year around, the bottom sediment of the tanks may change. However, currently, there are no information how it would change. (by NCPCP) Further information is required to assess the impacts.	C
Protected Areas	C	There are some forest reserves in the target area. However, the projects should not give adverse impacts as it does not have any plans to expand the agricultural land in the forest reserves.	D
	O	Direct adverse impacts on protected area are not expected. On the contrary, NCPC water will provide better environment for aquatic creatures and birds year around.	D
Flora, Fauna and Biodiversity	C	Only limited clearance of vegetation in the areas is expected. Disturbance of activities of animals and insects by construction, such as limiting access to water, may occur during the construction period although it is only for a limited period. (by IF-1)	B-
	O	It may affect the ecosystem in *Yala* as water will be provided throughout the year. However, the impacts are not clear at the moment. It may be positive rather than negative. Successful rehabilitation works induce return of native species of flora. (by IF-1) Further information is required to assess the impacts.	C
Hydrological Situation	C	The construction may affect hydrology of the cascade system, although it would be only short-term. (by IF-1)	D
	O	Irrigation water drawn from the NCPC into the minor tanks will change the hydrology of each tank, cascade systems as well as the downstream rivers. In order to avoid flooding in the *Maha* season, and over flow and damage of the tanks and water channels, careful planning and monitoring of water distribution system are required. (by IF-1) Further information is required to assess the impacts.	C
Topography and Geographical Features	C	No impacts on topography is expected.	D
	O	If the management of the catchment forests is neglected, there is a risk to change the topography in the project areas. (by IF-1, IN-4)	B-
Involuntary Resettlement	C	Land for link-canals and tertiary canals is required to be secured, but no other land acquisition or involuntary resettlement is expected. (by IF-1)	D
	O	No plans for land acquisition or resettlement.	D
Poverty	C	Part of the construction of irrigation restoration and inter-tank water channels may be implemented by farmers' participatory method. This will give a positive impact on poor farmers' income. (by IF-1)	B+

	O	Enhanced agriculture and livestock production will likely increase farmers' income, which contribute to alleviating poverty and vulnerability. (All)	A+
Indigenous People and Ethnic Minorities	C/O	Special consideration shall be given to the relationship amongst ethnic, religious and social status of the groups in order to avoid building tension or feeling of unfairness. (by IF-1, 2, IN-3, 4) There is no indigenous people living in the area.	B±
Local Economy such as Employment and Livelihood, etc.	C	Construction work of infrastructure will be contracted out to local companies, and local labourers will be employed. This will give a positive impact on local economy. (by IF-1)	B+
	O	Enhanced agriculture production will likely increase farmers' income. Diversification of agriculture products and processing industries will activate local economies and increase employment. Positive impacts are expected by the appropriate flood and drought disaster mitigation plans. (by All)	A+
Land Use and Utilisation of Local Resources	C	Some parts of the nearby farmland may be used for construction sites and facilities. However, it is only temporary. (by IF-1)	D
	O	Agriculture in the peripheral areas will also be promoted. More effective use of land and local resources is expected. Illegal encroachment of paddy land should be prevented. (by All)	A+
Water Use	C	Farmers cannot have access to water for agriculture during the construction period. However, it is temporary and impacts are minimum. (by IF-1)	D
	O	Efficiency of water usage will be improved by the planned water distribution system. (by AG-2, 4, IF-1, 2, IN-1, 2, 3, 4)	A+
Existing Social Infrastructures and Services	C/O	Existing infrastructure is upgraded. (by IF-1). More active involvement of FOs and CMOs as well as local government institutions is expected. (by All)	B+
Social Institutions	C	New relationship with farmers of neighboring tanks in the same cascade system and government institutions/officers will be generated through planning and working as CMOs. (by IF-1)	B+
	O	In addition to the relationship amongst CMO members, the relationship with other actors will be newly generated in the process of diversification of agriculture. Social capital and social organisation are supposed to be broadened and strengthened. Power dynamism in the communities may change. (by All)	B+
Mis-distribution of Benefit and Damage/ Local Conflict of Interest	C	Some construction works for restoration of the tanks may be contracted out to communities and famers. Employment procedure and opportunities should be fair to avoid local conflict amongst farmers. (by IF-1)	D
	O	There are risks that could induce local conflicts by NCPCP. Establishment of sound and fair cascade water management bodies is the key to avoid local conflict. (by IF-2, IN-1, 2, 3, 4)	B±
Cultural Heritage	C/O	Although Anuradhapura District has many historical and cultural heritage sites, the project areas do not overlap with these heritage sites and will not cause any physical damages or indirect damages such as changes of landscape, to any of the notified sites. (overall)	D
Landscape	C/O	There will be some chances in landscape during construction. However, landscape in the area will be improved when traditional cascade systems are restored, having more water in the system. (by IF-1)	B+
Gender	C	Tanks are used not only for agriculture purposes but also for households such as washing closes, basing, etc., in which women take major roles. Women's participation in planning and consultation processes of irrigation system need to be secured, particularly women in vulnerable condition, in order to find out how this project can improve gender equality in irrigation farming's. (by IF-1)	B+
	O	Improvement of water availability and efficiency may give positive impacts on gender equality. More chance to women may be generated to participate in the economic activities. (by All)	B+
Children's Rights	C	It is necessary to pay attention not to use children for labour. (by IF-1)	D
	O	No impact on children's rights is anticipated.	D
Infectious Diseases such as HIV/AIDS, etc.	C/O	No impact on infectious diseases is expected. (by IF-1)	D

Working Condition	C	It is necessary to give enough consideration to the working environment of construction workers. (by IF-1)	B-
	O	No task that causes negative impacts on farmers is expected.	D
Accidents	C	In order to avoid potential accident, close attention is needed during construction and rehabilitation period. (by IF-1)	B-
	O	Increased usage of agricultural machineries and chemicals could increase risks of accidents without proper instructions. (by AG-1, 2)	B-
Cross-border Effects	C	Some small rivers and medium tanks that are not in the target area but connected to the target cascade systems may be affected, like having turbid water during construction and rehabilitation period. (by IF-1)	B-
	O	Return flow from NCPC may increase the river flow downstream, which may affect the water ecosystem in the river and surrounding. It is not yet clear at the moment. (by IF-1) Some spillover positive effect on neighboring areas of agriculture promotion may be possible. (AG-1, 2, 3, 4, PM-1, 2, 3, LS-1, 2)	B+

C: Construction Phase, O: Operational Phase, B-/+: Positive/negative impacts are expected to some extent, C: Impacts are unknown, D: No impacts are expected
Source: JICA Project Team

(3) Additional Information on Impacts

(a) Pollution Such as Water Pollution, Soil Contamination, Solid Waste, Noise and Vibration Caused by the Infrastructure Construction

Implementation of "Cascade System Facility Development Project (IF-1)" including restoration of tanks, farm roads, link-canals, etc., may cause some pollution listed below during the construction period:

- Soil pollution due to fuel leakage from the heavy machinery and vehicle used for construction. This depends on the condition and maintenance of the equipment and vehicles;
- Water pollution from contamination of the bottom sediment of the tank, leakage of fuel from construction heavy machinery and vehicles, water pollution due to contamination of construction materials such as cement, soil, and sand used for the attached irrigation facilities;
- The possibility of water pollution caused by the abovementioned materials outside the project target area (downstream);
- A solid waste such as branches and leaves of trees generated by vegetation clearance, earth waste by dredging, concrete debris from old tank parts, etc.;
- Household waste, human waste from the labour camp; and
- Noise and vibration due to construction.

Occurrence of the pollution is limited during the construction period, and impacts will be limited as the construction sites are not adjacent to the residential area in many cases.

(b) Land Acquisition / Involuntary Settlement

Land for the construction of link-canals and tertiary canals in IF-1 sub-project will need to be secured. It is foreseen that the land used for this purpose will be voluntarily contributed by farmers, and no other land acquisition or involuntary resettlement is expected. The locations of both link-canals and tertiary canals will be decided through consultations with the farmers. Sufficient consultation with stakeholders is necessary in the planning stage.

(c) Biodiversity

The impacts of NCPCP on biodiversity was discussed in the earlier part of the chapter. Main impacts on biodiversity by the implementation of the Development Plan are likely generated during the construction period: Fauna and flora that are living in trees and bushes in spillways and tank bund will be disturbed due to the clearance of these plants for rehabilitation work. Also, there will be loss of access to the tank water during construction period. Especially during the *Yala* season, fish and birds living around the tank will be affected as water from the irrigation tank is removed for construction, although this would only be temporary.

(d) Requirement for Approval and Licences

The materials used for the rehabilitation of the tanks and farm roads must be obtained by legitimate methods with proper procedures. The soil will have to be taken from the designated places as directed by the Department of Agrarian Development DAD or Provincial Department of Irrigation (PDOI)

(commissioned by the Divisional Secretary (DS) Office), and sand and gravels have to be purchased from the providers who have the licence.
The proposed rehabilitation of the tank systems include clearance of bushes and small trees left untouched for a long time. For the clearance of trees and bushes, permission from the DS office is required. In case of removing the tall trees, a proper clearance is required from the Forest Department, in accordance with the Felling of Trees Control Act No. 9 of 1951 and amendments.

(e) Employment of Workers and Accidents in Construction Work

It is important to pay attention to fair employment and services when procuring labour for infrastructure construction work from the local communities. Process of employment and remunerations must comply with the laws and regulations of Sri Lanka, and there should not be any discriminations based on gender, ethnicity and social status. No child labour shall be hired.
It is also necessary to take accident prevention measures in construction work, including providing workers with appropriate equipment (such as helmets, shoes, clothes, etc.), putting signs and fences at construction sites in order to prevent outsiders from wondering into the sites and causing accidents during construction period.

(f) Increased Agro-Chemicals for Crop Diversification and Expansion of *Yala* Cultivation

Rice is currently cultivated only in 20% to 25% of the command area in the *Yala* season, but with the implementation of the Agriculture Development Plan (AG-1, 2, 3, 4, HG-1, 2, 3), rice and other crops including vegetables will be also cultivated in about 60% of the command area. The amount of chemical input will likely be increased more than before since vegetables require more chemical inputs such as fertilisers and pesticides than paddy.
In the Northern Central Province region, there are many people suffering from kidney diseases. Many studies point out that this is caused by cadmium and arsenic contained in rice at high concentrations, and these heavy metals may derive from the agricultural chemicals used for rice cultivation. There are criticisms that the government is responsible for that by promoting high-input farming method for productivity improvement and by paying a large subsidy for chemical fertiliser / agricultural chemicals to farmers. (However, the exact cause of the disease is unknown). In Sri Lanka, pesticides are regulated by the Control of Pesticides Act, and the use of about 40 harmful pesticides is prohibited. In 2015, the president prohibited glyphosate (the main ingredient of Roundup (pesticide). The subsidy for fertiliser also stopped in 2015. According to Food and Agriculture Organisation (FAO) data[8], the amount of pesticide and chemical fertiliser used per unit area in Sri Lanka is not particularly high compared with the use of other countries in the world (pesticide usage is very low, compared with the equivalent level in India). Nevertheless, it is essential to control the usage amount of agro-chemicals in order to avoid water and soil pollution.
In the "Cultivation Skills Development and Provision of Quality Input to Booster Crop Diversification" sub-project (AG-2) has a component to train farmers to use agro-chemicals in right timing and right quantities, which functions as a built-in mitigation measure itself.

(g) Increased Livestock Waste

The water level of the tanks will rise as a result of the project, and pasture land will decrease during the *Yala* season. The "Enhancement of Livestock Management Extension System" sub-project (LS-2)" encourages stall-feeding of dairy cows for better milk production. As a result, waste from livestock in cattle sheds could increase and cause the water and soil pollution, flowing out from sheds, unless it is treated properly. Livestock farmers in Sri Lanka currently have no habit of making manure from livestock waste, and now there is a situation that the waste is left piled in the back of the livestock sheds, thus leaking into the water. This issue is expected to be addressed to some extent in the LS-2 sub-project.

(h) Elephant-Human Conflict vs. Needs for Conservation

Although this area is not identified as an Elephant Corridor, it is estimated that there are about 600 elephants in Anuradhapura District and Wilpattu National Park, according to the Department of Wildlife Conservation of Anuradhapura. Large herds of elephants can destroy wide areas of crops, such as rice and maize, in a single night. A study shows that an average farmer in elephant-affected areas loses over USD

[8] https://ourworldindata.org/fertilizer-and-pesticides/#pesticide-application-rates

200 annually from crop damage[9]. But damage is not only on the crops. They often harm minor tank systems. Damage on the tank bund is observed in the project target areas. Some areas are protected by electric fencing, which is considered to be the most effective strategy at present but very expensive at the same time. Farmers cannot do much about it by themselves. On the other hand, the elephants are considered as sacred animals to Sri Lankans. There is a need for conservation of elephants as it is currently designated as an endangered species. Their habitat may be affected by the promotion of agricultural activities expanded by the NCPCP.

(i) Local Conflict of Interest regarding Water Distribution: Upstream vs. Downstream, Different in Size, Ethnic Groups, Social Status, etc.

Water management is a very sensitive matter, particularly in the *Yala* season, in the Dry Zone, and local dissension could be induced amongst farmers if careful consideration on water distribution and management system is not given. As mentioned in Chapter 6, there are some cascades that communities of different ethnic groups such as Muslim and Sinhala or Sinhala and Tamil are mixed, and the farmers use different languages. There are also communities in which farmers of different social status are mixed. In such case, generally speaking, often the opinions of minorities are easily ignored. In addition, differences in the location in the cascade, e.g., upstream versus downstream or size of FO / community also contribute to the power and interest struggle amongst communities. Even in the current FO which is formed by farmers operating only one tank, disputes related to water management sometimes occur, and there are many cases where intervention of the ASC officers is required to settle the issue. (Thorough analysis on this issue is made in the section of "7.5 Establishment of Cascade Management Organisation" in Chapter 7.) Sufficient consideration must be given to this issue because discord between FOs / communities not only hampers good management of CMO and effective water management but also induces instability in the area. Institutional Development Plan, in particular "Establishment of Cascade Management Organisation (IN-3)" and "Improving Capacity of FOs in Tank Level Water Management (IN-4)" address this issue.

(j) Gender

As discussed in Chapter 3, participation of women in the development activities and decision-making process is low in rural Sri Lanka due to the lack of capacity, cultural and social background and limited information and opportunities given to them. In most cases, half of the members of a FO are female because both husband and wife of a household belong to the same FO. However, there are very few female FO representatives (office bearer). It is assumed from this current situation that females will not be chosen as representatives of CMOs when they are established. Also, as for participation in decision making, usually husbands, not wives often participate in the FO meeting on behalf of each family. Particularly in the Muslim FOs, participation is limited only to male members. Female members have less opportunities to participate in decision making, getting information, and getting services or support from the government. In the Development Plan, gender issues are taken into account.

(4) Summary of Impacts

Table 9.2.5 provides a sub-project level summary of the impacts. It shows that the Development Plan has a wide range of important to moderate positive impacts, and only very few low or negligible negative impacts.

[9] *"An assessment of the human-elephant conflict in Sri Lanka"*, Ceylon Journal of Science (Bio.Sci.). Vol 39(1). 21-33, Santiapillai, C.,et.al. (2010).

Table 9.2.5 Overview of Anticipated Impacts of Sub-Projects

	Agricultural Development				Postharvest and Marketing Development			Livestock Development		Infrastructure Development			Institutional Development			
Project	**AG-1**	**AG-2**	**AG-3**	**AG-4**	**PM-1**	**PM-2**	**PM-3**	**LS-1**	**LS-2**	**IF-1**		**IF-2**	**IN-1**	**IN-2**	**IN-3**	**IN-4**
Phase	O	O	O	O	O	O	O	O	O	C	O	O	O	O	O	O
Pollution and Physical Environment																
Air Pollution	*									*						
Water Pollution	▲	▲							▲	▲						
Waste									▲	▲						
Soil Contamination		▲							▲	*						
Noise and Vibration	*	*								*						
Offensive Odors										*						
Bottom Sediment										△	NC					
Natural Environment																
Flora, Fauna and Biodiversity										▲	NC					
Hydrological Situation										*	NC					
Topography and Geographical Features											▲					▲
Social Environment																
Poverty	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△
Indigenous People and Ethnic Minorities										△▲	△▲	△			△	△
Local Economy such as Employment and Livelihood, etc.	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△
Land Use and Utilisation of Local Resources	△	△	△	△	△	△	△	△	△	*	△	△	△	△	△	△
Water Use		△		△						*	△	△	△	△	△	△
Existing Social Infrastructures and Services	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△
Social Institutions	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△
Misdistribution of Benefit Damage, Local Conflict of Interest										*	△▲	△	△	△	△	△
Landscape										△	△					
Gender	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△
Children's Rights										*						
Working Condition										▲						
Accidents	▲	▲								▲						
Cross-border Effects	△	△	△	△	△	△	△	△	△	▲	NC					

*C : construction phase, O: operational phase, ▲: negative impacts, △: positive impacts, *: negligible, NC: not clear at the moment*
Source: JICA Project Team

9.3 Comparison to the No-Project Alternative

In this section, in addition to the environmental and social impacts to be generated by the implementation of the Development Plan, other aspects (such as effective use of irrigation water; economic effect; disaster risk; and impacts on society and organisation) are evaluated in comparison with an alternative, in which only NCPCP infrastructure construction is implemented and the Development Plan is not implemented (zero option). Table 9.3.1 shows the results of the comparison of these two cases.

Table 9.3.1 Compared Impacts of the Development Plan with No-Project Alternative

	With Development Plan	Without Development Plan
Impacts on Environment	**Medium to Low** • Some temporary pollution on air, water, soil, noise, etc., may be caused by the construction work • Failure to properly use the chemical fertilisers and pesticides could cause water pollution and soil contamination • Failure to properly process livestock waste could cause water pollution and soil contamination	**Medium** • Unplanned flow of NPC water could cause poor drainage and leads to deterioration of farmlands, balanced ecosystem, and irrigation tanks. • Abundant tanks and command areas will not be rehabilitated/recovered, and the farmland will be lost forever.
Effective Use of NCP Water and other Irrigation Water	**High** • Multiple layers of institutions for water management will be created, and water will be properly managed. Based on the concept of "equitable share", water is distributed proportionally to the irrigable area held by each cascade and the water in the cascade is managed by CMO. • Tanks and related facilities as well as farm roads will be rehabilitated, which is essential for effective and efficient usage of NCP and other irrigation water	**Low** • (Without a proper water management system, rehabilitation of the tanks and related facilities, setting up the water management institutions,) ineffective water distribution inside the area and a cascade system is likely to happen: the upstream tanks could be flooded due to excessive water and the downstream tanks could lack in water.
Impacts on Economy in the Target Area	**High to Medium** • Annual agricultural production could increase by one million tons, and net profit reaches 23 billion rupees in 30 years • Employment opportunities will increase (for about 40,000 people) in processing and sales of agricultural products • Economic benefit will be 755 billion rupees in 30 years (converted to present value as of 2012)	**Low** • Cultivation area may increase to some extent during the *Yala* season, but many farmers continue rice production and cropping intensity and profitability remain low • No drastic increase from the current average income of 88,600 rupees in *Maha* and 12,800 rupees in *Yala* season without effective and efficient use of NCP water
Impacts on Disaster Prevention	**Low** • Rehabilitation of the tank bund, spillway and other irrigation facilities will enhance tanks' discharge and drainage capacities and reduces risks of damages on the tanks as well as on agriculture produces caused by heavy rains and flooding • Improve tolerance toward flood and drought due to better water management inside a cascade.	**High** • Due to the increased volume of water by NCPC, there is a high risk of damages on tank bund, farm roads, culvert, and spillway as well as discharge of sediments by heavy rain. Furthermore, the domino effect may cause damage to the downstream tanks. • Low drainage capacity may cause flood in the farm lands
Adverse Impacts on Society	**Low** • Established water management system and activities in the plan to ensure equal benefit of NCP water to the farmers and promote mutual understanding amongst stakeholders in the target area, which will lower adverse impacts on society and contribute to the stability of the area	**High** • No adjustment of water distribution amongst tanks in a cascade could cause increased disputes regarding water allocation and management, leading to regional instability • Increase the risk of encroachment of land and illegal cultivation
Others	• Food security in the region will increase	

Source: JICA Project Team

The table shows that the Development Plan lessens risks and enhances the benefits to be generated by NCPCP. Implementing the Development Plan is far more beneficial than the "no project" alternative, not only for conservation of the environment, but also socially, economically, and for disaster prevention.

9.4 Mitigation Measures

Table 9.4.1 provides a summary of the mitigation measures for addressing the negative impacts that could be generated by the implementation of the Cascade System Development Plan, which were mentioned above. Some measures that address the issues that may be relevant to NCPCP are also included. These measures are indispensable for environmental and social sustainability of the cascade system and the prosperity of the people in the target area. Their strict application is required.

Table 9.4.1 Environmental and Social Issues and Mitigation Measures

Aspects	Issues	Mitigation Measures
Construction Phase		
Pollution	• Pollution from infrastructure construction	Ensuring that the contractors comply with the requirements related to safety management, pollution control and social consideration, by including clauses in the tendering documents, etc. Making periodical reports to the PMO is mandatory 1) Environment / pollution control • Acquisition of permission from DS for logging of trees • Preliminary confirmation with the Irrigation Department about excavation methods and locations of soil / sand / gravels, etc. • Maintenance and management of construction vehicles • Noise and vibration control measures, construction time periods • Wastewater and waste management • Recovery of soil removal sites and construction roads 2) Social consideration • Prohibition of child labour • Employment discrimination prohibited by women and ethnic minorities • Maintaining impartiality in employment 3) Safety measures • Working environment for workers (provision of appropriate dormitories, sanitation, compensations, etc.; • Guidance and provision of appropriate clothing; • Maintenance and management of construction vehicles and equipment; and • Installation of signboards and safety fences.
Per-mission and Licence	• Compliance with laws and regulations related to logging, material acquisition, etc. • Recovery of soil removal sites, construction sites, roads, etc., after the completion of construction	
Social Environ-ment	• Uneven distribution of benefits, discrimination for ethnic minorities, gender, violating children's rights in employment of workers, etc. • Compliance with laws relating to employment and labour conditions	
Accidents	• Occupational health and environment • Risk of accidents	
Natural Environ-ment	• Disturbance on fauna and flora by construction	Implement construction work efficiently to finish it as planned in order to minimise the burden on ecosystems
Operational Phase		
Natural Environ-ment	• Adverse impacts on biodiversity by increased irrigation water	Conducting periodical monitoring of the ecosystem, especially on the endangered species living in the target area, and recording changes
	• Deforestation of catchment area by losing incentives for preservation	Preservation of catchment area is essential for farmers for both collecting the rainwater as well as preventing silt flowing into the tank. Also, Forest Ordinance and Felling of Trees Ordinance prohibit arbitrary logging and development of forests. Including forest conservation and management activities around the tank in TOR of CMO, and conduct educational activities to CMO members.
	• Encroachment of farm land	Expansion of farmland is prohibited by the Agrarian Development Act and DAD and PDOI are strictly supervising. The clauses of banning the illegal / un-planned cultivation should be included in the CMO operation regulation.
	• Elephant damage and conservation	So far, no other effective countermeasures but putting electric fences are suggested. The fences have gradually been put up along the elephant passages by DWC, but the progress is slow as electric fences are expensive. SEA of Mahaweli Water Security Investment Program suggests to set up forest reserves for elephant ecology and migratory passages in the north part of the project target area. The mitigation measures should be implemented carefully considering both prevention and conservation aspects. Elephant watch could be conducted as part of the CMO activities.
Pollution	• Water and soil pollution by increased agro-chemicals for crop diversification and expansion of the *Yala* cultivation	Application of proper amount and timing of approved pesticides and fertilisers, and encourage effective and safe application of these led by ASC Promotion of the organic farming, which also has high marketability

		could be one of the good mitigation measures Promotion farmyard manure, which is hardly practised at present, is a good way to reduce dependency on agro-chemicals
	• Salt damage	Careful design of proper drainage and water distribution system in order to avoid water logging in the command area Giving instructions to farmers to comply with the adequate amount and timing of approved pesticides and fertilisers Continuous monitoring of soil analysis
	• Water and soil pollution by increased livestock waste	Guidance to livestock farmers on proper improvement of the sheds Promotion of manure production and management Promotion bio-gas making from the waste
Social Environ-ment	• Change in social capital: Disappearance of traditional Bethma cultivation and as such	Bethma system will be replaced by the group activities through agricultural activities in production / marketing and provide a new social capital.
	• Local conflict of interest: Upstream vs. Downstream, Large vs. Small, Difference of Ethnic Groups, Social Status, etc.	Establishment and operation of a water management system that ensure equal benefit of NCP water and promotion of mutual understanding amongst member FOs, including the following: • Establishment and dissemination of fair CMO rules • Keeping and circulating records of CMO meetings • Creation of a mechanism (quota system) to include minorities in CMO's Executive Committee member / bearer • Fair mechanism of selecting a water master • Establishment of transparent water distribution system and a feedback system that reflects previous years' performance • Creating and sharing CMO meeting minutes • Promotion of the use of both Tamil and Sinhala languages for CMO management • Involvement of government agencies (attendance of DO / ARPA to decision making occasions, employment of ARPA) • Establishment of a mechanism for appeal of grievance (to create a system that can directly appeal when one's opinion was ignored because of dissatisfaction and minority) • Implementation of awareness training for farmers and government officials Strengthening cooperation amongst supporting government agencies (ASC, PDOI, DAD).
	• Gender	In order to encourage women's participation in CMOs and FOs meeting and activities and incorporate their ideas and opinions, it is essential to pay special attention to their needs and requests. These include the following: • Avoid setting the meeting time when women are busy with household chores. • Hold meetings for women and allow them to bring their children to the meeting. • Set quotas for women participation in the meetings, or even for representative selection • Create CMO female branch and implement unique activities, etc.

Source: JICA Project Team

9.5 Monitoring Plan

It is very important to make efforts to contain and minimise any negative impacts that may be generated by the implementation of the Development Plan through periodic monitoring. The following section explains the suggested monitoring arrangements. Table 9.5.1 summarises the monitoring program during the construction and operational phases.

(1) Monitoring Arrangements

The Project Management Office (PMO) is primarily responsible for the environmental monitoring. It should put in place an effective structure and mechanism for environmental management, such as establishment of a special unit staffed with officers who has skills and experience in environmental management. In addition, issuance of penalties and fines for non-compliance and violations could be its task. The unit coordinates and liaises with the management consultant, receiving periodical monitoring reports, supervise the contractors' activities, give advice and directions related to environmental issues, during construction period. Actual tasks in the field are managed and implemented by the Provincial Director of Irrigation (PDOI) in Anuradhapura and Department of Agrarian Development (DAD) in

Vavuniya District, in cooperation with the CMOs and local contractors. In operational period, PMO performs in coordination with related organisations. The roles of the unit also includes; communicating with project stakeholders such as CMOs and government agencies, reporting monitoring results and issues to the Project Director, taking actions to solve the issues raised by the contractors, and liaising with other PMO members.

The monitoring results are to be reported yearly to the Ministry of Mahaweli Development and Environment (MMDE) or Ministry of Irrigation and Water Resources Management (MIWRM), provincial governments, and CEA.

(2) Monitoring Program

Table 9.5.1 Monitoring Program

Issues	Monitoring Items	Responsibility	Venue	Frequency
In Construction Phase				
Water pollution by soil and cement	pH, colour, turbidity	PMO, PDOI, DAD Contractor	2 points around sluice area and dawn stream in the canal in command area	Monthly
Contamination of leaked oils and fuels from construction vehicles and equipment	Condition of construction vehicles and equipment	PMO, PDOI, DAD Contractor	Construction site, Parking and working area of vehicle and equipment, 2 points each	Weekly
Solid waste (debris and bio-waste from the tank rehabilitation, waste from labours' camp)	Status of collection segregation of wastes and treatment	PMO, PDOI, DAD Contractor	Construction site, Labour camp	Monthly
Proper permission and certificate for excavation and felling of trees related to tank rehabilitation	Confirmation of work plan, license requirements and status for approval	PMO, PDOI, DAD Contractor	N/A	Before the commencement of construction
Fair employment and compliance to the labour law （Misdistribution of benefit, local conflict of interest, minority, gender, children's rights, working condition）	Employment and compensation procedure and status, complaints from workers	PMO, PDOI, DAD Contractor	Construction site	Monthly
Working environment and sanitation	Safety and sanitary condition of the camp, provision and furnish of safety gear	PMO, PDOI, DAD Contractor	Construction site, Labour camp	Bi-monthly
Accidents	The number of accidents, installation and avoidance of safety procedures	PMO, PDOI, DAD Contractor	Construction site	Monthly
Biodiversity	Change in inhabitation of fauna and flora as well as biodiversity	PMO DWC,FD, CMO	Inside the cascade system (tanks, catchment area, command area, hamlet area, etc.)	Quarterly
Recovery of construction sites	Status of soil excavation site, construction sites, camp, construction roads, etc.	PMO, PDOI, DAD Contractor	Soil excavation site, construction sites, camp, construction roads, etc.	After completion of construction
In Operational Phase				
Water pollution from agri. chemicals	pH, colour, turbidity, heavy metal, salt, residual agro-chemicals*	PMO, PDOI, DAD CMO	2 points around sluice area and dawn stream in the canal in command area	Twice a year
Soil contamination and salt pollution by excess usage	Composition and concentration of salt in the	PMO, PDOI, DAD	3 points inside the command area	Twice a year

of agro. chemicals	soil	CMO		
Livestock waste, risk of water and soil contamination	Situation of livestock waste treatment by famers	PMO, PDAPH, CMO	3 to 5 livestock sheds per CMO	Twice a year
Biodiversity	Change in inhabitation of fauna and flora as well as biodiversity	PMO, PDOI, DAD, DWC, FD, CMO	Inside the cascade system (tanks, catchment area, command area, hamlet area, etc.)	Yearly
Elephant	Damage status	PMO, DWC, CMO	Inside the target area and peripheral areas	Yearly
Neglect of conservation of catchment forest area and encroachment	Status of conservation of catchment area, Confirmation of no illegal expansion of cultivation	PMO, PDOI, DAD, FD, CMO	Inside the cascade system	Yearly
Conflict amongst members of CMO regarding water management	Status of farmers' compliance of CMO regulation Conflict amongst CMO members	PMO, PDOI, DAD, CMO	N/A	Regular basis
Gender	Participation of female members to CMO activities, training opportunities, decision making, etc.	PMO, PDOI, DAD, CMO	N/A	Regular basis

*Note: * Since advanced technology and equipment are necessary for detecting residual of agricultural chemicals, monitoring is carried out to the possible extent, considering the situation of the site.*
Source: JICA Project Team

9.6 Conclusion and Recommendation on Environmental and Social Considerations

The assessment finds that there are risks of causing negative impacts on some social and environmental issues by implementation of the Cascade System Development Plan. Nevertheless, these negative impacts would relatively be minor and could be avoided or minimised by undertaking mitigation measures and implementing strict monitoring. Also, it appears that implementation of the Development Plan would result in better outcomes from NCPCP in comparison to the "non-project" alternative, based on the concept of the Strategic Environmental Assessment (SEA).

As explained in Chapter 5, this project, in the first place, aims to transform the cascade farmers into a sustainable "economic entity" by enhancing their livelihoods and incomes with proper land and NCPC irrigation water utilisation and management. It also proposes measures for mitigating social and physical risks caused by NCPCP.

The proposed Development Plan would contribute to achieve these goals, but it is essential to undertake mitigation measures and ensure monitoring to minimise the adverse environmental and social impacts that may be caused not only by the Development Plan but also by the NCPCP.

Finally, this environmental social assessment was conducted with respect to a hypothetical situation as NCPCP has not been started yet. Also there is a difficulty to separate the impacts to be brought about by the NCPCP and the Development Plan. Therefore, it is recommended that a reassessment of the environmental impacts be conducted after the completion of the EIA result of NCPCP.

Chapter 10 Conclusion and Recommendation

10.1 General

This chapter concludes the project for formulating cascade system development plan under North Central Province Canal (NCPC) and describes the recommendations for future implementation of the cascade development plan.

10.2 Conclusion of the Cascade System Development Plan

The Project achieved the following findings through Project implementation.

The National Food Production Programme 2016-2018 is one of the most important government policies in agriculture and irrigation development in the country and sets the production targets for major crops including paddy, coarse grain, legumes, condiments, vegetables, fruits, milk and meat; as well as including paddy, coarse grain, legumes, condiments, vegetables, fruits, milk and meat; as well as The North Central Provincial Canal Project (NCPCP) is planned as one of the components of the Mahaweli Water Security Investment Programme (MWSIP) Phase 2 to be funded by the Asian Development Bank (ADB). The study was carried out based on the results of the FS dated on April 2016. The NCPCP targets to provide irrigation water to 128 cascade systems located over eight District Secretariat (DS) divisions in Anuradhapura District and four DS divisions in Vavuniya District. Since agriculture is one of the important economic sectors in the two districts, namely: Anuradhapura and Vavuniya about 55.0% and 33.8%, respectively, are engaged in agriculture. The NCPCP is expected to uplift the local economy and livelihood of the population in those areas. A total of 128 cascade systems including 1,024 tanks, 31,446 ha of irrigable land, and 33,515 farm households benefited by NCPCP. The target 128 cascade systems are located in the five river basins, namely; Malwathu Oya, Yan Oya, Ma Oya, Parangi Aru, and Kanagarayan Aru.

The main crop cultivated in the lowland of the project area is paddy while maize, millet, green gram, black gram, cowpea, chilli, onion and low-country vegetables in the highland in *Maha* season. The cultivation in *Yala* season is limited due to insufficient water supply. The yield of paddy is 3.0 ton/ha, it is lower than the national average. The Government of Sri Lanka (GOSL) directly intervenes with the paddy/rice market by setting guaranteed prices and providing opportunity for farmers to sell the product directly to Paddy Marketing Board (PMB) and Multi Purpose Cooperative Society (MPCS). In addition, private purchasing is also significantly taking place in the project area. Dedicated Economic Centres (DECs) located near the project area can be accessed by farmers for selling their other field crops (OFCs), vegetables, fruits, and other crops. Agricultural extension service is carried out by Provincial Department of Agriculture (PDOA) in association with the Department of Agrarian Development (DAD) in the project area.

Livestock is also one of the income sources of farmers in this area. About 11% of the farm households reared cattle and the average cattle holding size is 6.6 livestock unit. Major cattle breeds in the area consist of Indian Crosses, European Crosses, and indigenous. The average milk production in Anuradhapura area is 2.8 L/cow/day and that of in Vavuniya area is about 1.0 L/cow/day. Provincial Department of Animal Production and Health (PDAPH) is involved with necessary extension support for livestock farmers in the area.

Irrigation facilities of minor schemes in the cascade systems are deteriorated and rehabilitation is essential. Major deterioration, which needs rehabilitation covers (a) tank bund erosion and the bund covered with thick jungle (b) intake facilities that include sluice and gates (c) spillways structure and downstream (d) eroded causeways and (e) eroded canal system in downstream. Currently, water management and minor repairs of minor irrigation schemes are generally done by farmer organisations (FOs) and the FOs are technically maintained by the Provincial Directorate of Irrigation (PDI) and DAD, or DAD alone.

FOs have been formed and are functioning in the project area on tank basis. FOs should be registered under the Agrarian Development Act No.46 2000 to receive a legal entity. All the FOs in the project area are registered and assisted by DAD. One of the major functions of FOs is the operation & maintenance (O&M) of irrigation facilities and water allocation within the area as per *Kanna* meeting decision. Majority of the FOs have their own fund through collection of periodical member fee, which is used for minor repairs and maintenance work.

The present economic viability of the cascade agriculture is low and this pose one of the biggest threats for sustainability. The present income level of the farmer is LKR 140,900, which is comparatively low with the secondary and tertiary sectors' income level and it is not attractive for farmers to encourage further investment and engage into intensive agriculture. Due to this situation, farmer loses interest in farming and becomes more dependent on non-farm income. Because of this, technologies may not be updated; agriculture productivity may decline; and agriculture, which is the key sector of local economy, may deteriorate.

To overcome this situation, the Project proposes to make cascade agriculture an "Economic Entity" to achieve a profitable agriculture with proper utilization of NCPC water. The profitable agriculture targets net income of more than LKR 500,000 per annum considering the middle level wage earners at the national level. It is proposed that this can materialise by improving the productivity of ordinal crop; diversify the market-oriented high value crops and varieties; and promote crop and livestock integration.

Through the detailed survey in selected six model cascade systems, (i) existing irrigation facilities and rural roads and rehabilitation needs, (ii) flood and flood mitigation measures, (iii) present O&M activities of infrastructure, (iv) establishment of simulation model for water distribution, (v) farm household economy and farming system, (vi) agriculture marketing and postharvest activities, and (vii) farmers organisation and extension service were collected. In addition, field verification programmes of (i) infrastructure rehabilitation and development for effective usage of irrigation water, (ii) assessment and mitigation of flood risk by farmers' organisation, (iii) promotion of agriculture diversification, and (iv) establishment of cascade management organisation were carried out. The collected data and findings were used to supplement the preparation of cascade system development plan.

Under the cascade system development plan for the benefitted area of NCPCP, agriculture development plan, postharvest and marketing development plan, livestock development plan, infrastructure development plan, and institutional development plan were proposed. On completion of the crop diversification program in the target area, 14,800 ton of traditional and high-value new paddy, 56,000 ton of condiments (chilli and big onion), 37,000 ton of maize, 31,000 ton of soybean, 2,300 ton of grain legumes (green gram and black gram) and 125,000 ton of vegetables are added to the total production annually. In case of livestock product, milk production volume will reach 54 million L per annum.

To materialise the proposed cascade system development plan, 15 projects are proposed for the coming ten years. "IF-1 Cascade System Facility Development Project" and "IF-2 Promote Public Awareness Campaign for "Tank Day"" are proposed under infrastructure development plan and "IN-1 Establishment of Management Structure of NCPC System", "IN-2 Establishment of Sub-watershed Level Management System", "IN-3 Establishment of Cascade Management Organisation", and "IN-4 Improving Capacity of FOs in Tank Level Water Management" are proposed under institutional development plan. There are four projects under the agriculture development plan, namely, "AG-1 Cultivation Skills Development and Provision of Quality Input to Booster Crop Diversification", "AG-2 Promotion of Farm Mechanisation", "AG-3 Improvement of Accessibility to the Fund", and "AG-4 Enhancement of Agriculture Extension System Platform"; and three projects under the postharvest and marketing development plan which are "PM-1 Establishment of the Community Supported Agriculture Model of High Value Vegetables in Partnership with Hotel Industry", and "PM-2 Promotion of Contract Farming of Other Field Crops" and "PM-3 Creation of the Value Chain of Traditional Rice Varieties" are proposed. "LS-1 Stable Feed Production and Delivery through Entrepreneur Development" and "LS-2 Enhancement of Livestock Management Extension System" proposed under the livestock development

plan. The implementation period of each project is one to seven years and the total estimated cost is LKR 36,819 million.

The environmental impact assessment finds that there are risks of causing negative impacts to some social and environmental issues by the implementation of the cascade system development plan. Nevertheless, these negative impacts would be relatively minor and could be avoided or minimised by undertaking mitigation measures and implementing strict monitoring. It also appears that implementation of the development plan would result in better outcomes from NCPCP in comparison to the "non-project" alternative, based on the concept of Strategic Environmental Assessment (SEA).

10.3 Recommendations

In terms of the Cascade System Development Plan implementation, the Project emphasises the following points for early and reliable implementation of the plan:

10.3.1 Completion of Feasibility Study of NCPCP with Review Results under Mahaweli Water Security Investment Programme Phase-1

The proposed Cascade System Development Plan is a part of the NCPCP and it is necessary to complete the feasibility study on total NCPCP for implementation of the Cascade System Development Plan. Without finalisation of distribution volume of the irrigation water to the cascade system and design parameter of the main canal system, the facility design in the cascae system can not be finalized. It is therefore that early completeion of the study by integration of both Cascade System Development Plan and review result of main and blance canal system including water balance study for entire Mahaweli system is needed.

In parallel with the Project, the preparation of the Phase-2 works under the Mahaweli Water Security Investment Programme including review of the feasibility study of the NCPC main and branch canal construction works and water balance study on the entire Mahaweli system is being carried out at present. According to the original schedule, the review of the water balance and feasibility design and planning of NCPC should be completed by July 2016 and May 2017, respectively, and planned to incorporate water balance study result into the Cascade System Development Plan; and cascade system development plan into the feasibility design and plans for NCPCP. However, for the water balance study, generation of stream flow time series data for daily time step requires stream flow estimation by a rainfall-runoff model, and such generation of stream flow data was not included in the original scope. Due to the additional scope to generate stream flow for daily time step, the water balance study is not completed yet at this moment.

The Cascade System Development Plan was prepared based on the feasibility study result carried out by Ministry of Mahaweli Development and Environment (MMDE) in April 2016 and it is necessary to update the proposed plans such as expected cropping calendar and link canal design based on the updated water balance study. In addition, as agreed in the 1st Joint Coordination Committee (JCC) meeting, MMDE should incorporate the revised cascade system development plan into the feasibility study of NCPCP for full completion of the planning and design.

10.3.2 Early Implementation of Cascade System Development Plan

It is recommended to take necessary actions including preparation of project proposal and fund arrangement immediately for implementation of the Cascade System Development Plan.

According to the original schedule of the Mahaweli Water Security Investment Programme, the construction of the main and branch canals of NCPC will be completed by 2024. Accordingly, the cascade system located downstream of NCPCP should also be rehabilitated and upgraded by the time of completion of the main and branch systems. However, the cascade system development works are out of scope on the Mahaweli Water Security Investment Programme so far therefore, it requires additional fund.

In addition, it has been urged to rehabilitate the tank irrigation systems in the project area since farmers could not cultivate in full extent for more than four cultivation seasons since *Yala* 2016 due to severe drought. As proposed in the action plans in Chapter 8, necessary rehabilitation works of tank irrigation system should commence prior to upgrading of the systems such as construction of link and tertiary canals even though there is prior commitment of ADB for financial support for Phase-2 programme. It

is also recommended that respective departments should initiate survey and investigation in advance following to the Cascade System Rehabilitation Procedure compiled in the Annex 5.

10.3.3 Sharing the Results and Collaboration with Other Ongoing and Planned Projects

It is recommended to share the result and collaborate on going and expected government and donor funded projects among Ministry of Mahaweli Development and Environment (MMDE), Ministry of Irrigation and Water Resource Management (MIWRM) and Ministry of Agriculture (MOA) and other related ministries.

With the aim of strengthening the resilience of smallholder farmers in the dry zone of Sri Lanka through improved water management to enhance the living condition and livelihood, the Climate Resilience Integrated Water Management Project (CRIWMP) is currently underway. The project will be implemented from 2017 to 2024 with the financial assistance of the United Nations Development Programme (UNDP) at about USD 38.1 million under the Green Climate Fund (GCF) and with co-financing amounting USD 14 million from GOSL.

The project has three main components and Upgrading Village Irrigation Systems is one of them. The project encompassed approximately about 325 village tanks in about 30 cascades located in three river basins, namely; Mee Oya, Malwthu Oya, and Yan Oya. Rehabilitation of irrigation facilities, restoration of watersheds, introduction of climate-smart ecological agriculture, improvement of marketing, preparation of cascade level climate resilience water management plan, preparation of O&M plan with FOs and enhancement of ASC capacities have been identified as main activities under this component.

Although the cascade systems covered under CRIWMP are located out of the Cascade System Development Plan area, both projects are focusing on sustainable development of cascade systems through enhancement of irrigated agriculture. Most of the activities covered under the Component 01 of CRIWMP are similar to the activities covered under the Cascade System Development Plan. The Project conducted the detailed survey covering the aspects of irrigation, flood management, agriculture, livestock, soils, marketing and farmers organisation in six pilot cascades which represent the 128 cascades. Findings of the survey and lesson learned during the Project period are documented with conclusions and recommendations in this report.

Other than CRIWMP, special project on minor irrigation development for targeting physical rehabilitation of the tank and irrigation system under DAD is also implemented in the target area. DAD, MMDE and MIWRM should collaborate for effective use of fund and experience toward to the implementation of Cascade System Development Plan.

10.3.4 Fair Distribution of Project Benefit

NCPC covers a large extent of area involving a huge number of farmers from different area and different communities. Therefore, proposed projects are implemented in different timeframe in different segments and some projects such as IF-2, IN-4, AG-1, PM-3 and LS-2 are undertaken in selected areas or selected farmers to demonstrate as pilot activities.

Even though the intensity of benefit from the project shall be highly influenced by the environmental and geographical situation of the area, project inputs should be fairly distributed among the beneficial area under the NCPC. It is recommended to implement the project activities with a certain strategy in resource allocation, the selection of pilot areas, and the order of executing the activities in consideration of regional balance, economic and social situations of the area to fairly benefit farmers from different communities.

10.3.5 Overall Project Management

The proposed projects are closely interrelated each other to achieve the overall goal of the project that is “Enhancement and stabilisation of farmers’ livelihood and income”. The overall project goal can be achieved through collaboration of all the proposed projects that are implemented by different government departments. Due to such interrelation, arrangement of implementation schedule through close communication between the relevant government agencies critical. Moreover, there are projects that should be executed in collaboration with related organisations. Even though the main implementing agencies are proposed, collaboration and ordination between all the concerned agencies

are necessary for efficient implementation of the total project. It is recommended to consider establishment of coordination body to oversee the whole project with clear division of roles between the agencies and coordination structure. Each agency should have a communication mechanism with an appointed officer in-charge for effective cooperation in each subject matter activities.

10.3.6 Utilising Development Activities for the Establishment and Enhancement of Cascade Management Organisation

Even though there is less social capital at this moment at the cascade level, it is necessary to unite several FOs in cascade basis to seek for additional benefits on agricultural marketing, smooth and economical farm mechanisation, and effective usage of irrigation water. Since farmers' organisation was formed in tank basis a long time ago, it requires change of famers' perspective and procedure in decision making to fit cascade level activity and management.

In order to create new sense of unity amongst farmers in the cascades, the project recommends implementing any type of development and rehabilitation activities related to agriculture and irrigation. This should be carried out by cascade basis so that it could accelerate the communication and discussion amongst the cascade level which will be the basis of unity.

In line with the recommendation above, the project proposes to establish a Cascade Management Organisation (CMO) for developing and strengthening unity of farmers at the cascade level and thereby CMO can attend to development activities in the cascade especially for O&M of irrigation facilities.

10.3.7 Integrate Government Support System into Cascade Management Organisation

In order to develop the capacity of CMO and supervise its activities, the Project proposes to give technical trainings such as water management and repair of facilities by the Provincial Directorate of Irrigation (PDI) and institutional trainings such as financial and organisation management by DAD considering the present departments' specified mandates and capabilities. Since the two organisations belong to the Ministry of Agriculture in the Central Government and Provincial Council, respectively, they could not provide one stop service to CMO and thus requires additional coordination on budgeting and planning amongst government departments. Since this can be one of the risks to reduce project efficiency, the Project recommends to integrate present DAD and PDI into one either in the Provincial Council or Central Government.

10.3.8 Seeking for Possible Utilisation of Verified Technologies

Through the verification programme, advantages of STEIN usage in the irrigation rehabilitation work and quality of equipment of water level recorder and telemetering facilities of OSASI Technos. Inc. were confirmed. However, since the distributor of STEIN element in the country is not available and environment clearance is not yet obtained, there is less possibility to expand the technologies for large-scale development activities so far. It is recommended that SPEC Company Ltd. and MMDE collaborate regularly to achieve the environmental certificate immediately and make necessary actions to establish the distribution agent in the country.

10.3.9 Expansion of Leasson Learnt Collected through Counterpart Training in Japan

Under the Project, 15 government officers in the central, provincial and district level were trained in Japan to strengthening of the development and management capacity on tank based irrigation system. The achievements of the training programme were used effectively for preparation of cascade system development plan, especially link canal design and evaluation of the effectiveness, water distribution plan preparation, cascade system organisation establishment and capacity development planning and preparation of the agriculture development plan to incorporate challenges for aging of farmers. The achievements in the counterpart training were not limited to the preparation of the Cascade System Development Plan, they could be utilised for other works related to irrigation and agriculture development. It is recommend to expand those lessons learnt to other government officers for improvement of government project planning and implementation capacity.

ATTACHMENT 1

RECORD OF DISCUSSION

RECORD OF DISCUSSIONS

ON

THE PROJECT FOR FORMULATING CASCADE SYSTEM DEVELOPMENT PLAN UNDER NORTH CENTRAL PROVINCE CANAL

IN

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

AGREED UPON BETWEEN

MINISTRY OF MAHAWELI DEVELOPMENT AND ENVIRONMENT

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

September 29th, 2015

Amada Kiyoshi
Chief Representative
Sri Lanka Office,
Japan International Cooperation Agency

R.M.P. Rathnayaka
Director
Department of External Resources,
Ministry of Policy Planning, Economic Affairs, Child, Youth and Cultural Affairs

Udaya R. Seneviratne
Secretary
Ministry of Mahaweli Development and Environment
"Sampathpaya" Rajamalwatta Road,
Battaramulla.

~~Nihal Rupasinghe~~ Udaya R. Seneviratne
Secretary
Ministry of Mahaweli Development and Environment

~~Gamini Rajakaruna~~ R.M.W Ratnayake
Secretary
Ministry of Irrigation

Eng. R.M.W. RATNAYAKE
SECRETARY
Ministry of Irrigation & Water Resources Management

B. Wijayaratne
Secretary
Ministry of Agriculture

B. WIJAYARATNE
Secretary
Ministry of Agriculture
No. 80/5, Govijana Mandiraya,
Rajamalwatta Avenue,
Battaramulla.

~~H.M.R.B. Herath~~ K.A. Thilakasiri
Chief Secretary
North Central Provincial Council

A.Pathinathan
Chief Secretary
Northern Provincial Council

A.Pathinathan
Chief Secretary
Northern Province

Based on the minutes of meetings on the Detailed Planning Survey on the Project for Formulating Cascade System Development Plan under North Central Province Canal, (hereinafter referred to as "the Project") signed on May 29th 2015 between the Ministry of Mahaweli Development and Environment (hereinafter referred to as "MDE") and the Japan International Cooperation Agency (hereinafter referred to as "JICA"), JICA held a series of discussions with MDE and relevant organizations to develop a detailed plan of the Project.

Both parties agreed the details of the Project as described in the Appendix 1.

Both parties also agreed that MDE, the counterpart to JICA, will be responsible for the implementation of the Project in cooperation with JICA, coordinate with other relevant organizations and ensure that the self-reliant operation of the Project is sustained during and after the implementation period in order to contribute toward social and economic development of Democratic Social Republic of Sri Lanka.

The Project will be implemented within the framework of the Agreement on Technical Cooperation signed on November, 2005 (hereinafter referred to as "the Agreement") and the Notes Verbales to be exchanged between the Government of Japan (hereinafter referred to as "GOJ") and Government of Democratic Socialist Republic of Sri Lanka (hereinafter referred to as "GoSL").

Appendix 1: Project Description
Appendix 2: Project Organization Chart
Appendix 3: A List of Proposed Members of Joint Coordinating Committee
Appendix 4: Tentative schedule of the Project
Appendix 5: Term of Reference (TOR) for Environmental and Social Consideration Study

Appendix 1

PROJECT DESCRIPTION

Both parties confirmed that there is no change in the Project Description agreed on in the minutes of meetings on the concerning Detailed Planning Survey on the Project signed on May 29th,2015.

I. BACKGROUND

GoSL formulated the Mahaweli Development Programme (MDP) with the aim of developing Mahaweli river basin and adjacent other river basins of North Central Province (NCP), Northern Province (NP), and Eastern Province (EP). MDP was conceived as a multi-purpose project serving, inter-alia, irrigation development, hydropower development and flood management.

However, in 1978, the GoSL decided to accelerate the implementation, with due consideration to the predicted increase of power demands and with a view to implement more industry oriented development. The Accelerated Mahaweli Development Project (AMDP) did not include Moragahakanda and NCP Canal Project (NCPCP).

GoSL has now decided that the NCPCP is a necessity to address water scarcity in NCP, NP, EP and North Western Province (NWP), and accordingly has assigned high priority for NCPCP. One of the areas to be developed by the NCP canal is cascade systems located on the either banks of NCP canal, extending over 33,000ha.

Under the above circumstance, the Project to develop cascade systems under NCPCP which envisages improved irrigation development, flood and draught management was requested by GoSL to GoJ.

II. OUTLINE OF THE PROJECT

1. Title of the Project
   The Project for Formulating Cascade System Development Plan under North Central Province Canal

2. Expected Goals which will be attained after the Project Completion
   <Output of the Project>
   Cascade System Development Plan under dry area of North Central and Northern Provinces
   <Expected Utilization of the Output>
   By developing cascade systems under NCPCP which envisages irrigation development, flood and draught management, to improve livelihood of cascade communities of the target area by promoting agricultural activities.

3. Outcome
   (1) Review of basic water supply plan from NCP canal to cascade systems
   (2) Rehabilitation and Improvement Plan for existing cascade irrigation infrastructure
   (3) Cascade Operation and Maintenance (O&M) Plan
   (4) Agriculture and Livestock Development Plan, Post-harvest and Marketing Improvement Plan, Capacity Development Plans of Farmers' Organization and the Extension Agencies of the Governments
   (5) Lessons learnt from demonstration activities for cascade water distribution, flood mitigation, rehabilitation and improvement, agriculture/livestock development and livelihood improvement at the selected model sites
   (6) Action plan for cascade system development, Manuals from demonstration activities
   (7) Environmental and social consideration

4. Activities

(1) Review basic water supply plan from NCP canal to cascade systems

① Collect existing NCP canal related data and water distribution plan in target area

② Collect existing cascade related data to categorize water supply cascade blocks

③ Review water supply and demand conditions and prepare basic water supply plan

(2) Prepare "Rehabilitation and Improvement Plan" for existing cascade irrigation related infrastructure

① Conduct survey about existing cascade irrigation related infrastructures including access road

② Study water distribution, current condition of irrigation infrastructures, categorizing cascades, tank siltation and disaster prevention measures for overall cascade infrastructure planning

③ Study the level and contents of rehabilitation and improvement works

④ Prepare basic design for rehabilitation and improvement including cost estimation

(3) Prepare "Cascade Operation and Maintenance (O&M) Plan"

① Conduct survey to grasp current status and problems in operation and maintenance by the water user groups

② Study needs of government intervention for effective and equal distribution of NCP canal water through cascades

③ Study and implement preparatory activities for formulation of committee for implementation of cascade O&M works, including government support system

④ Prepare cascade O&M plan, including preventive activities for flooding disaster and damages

(4) Prepare "Agriculture and Livestock Development Plan", "Post-harvest and Marketing Improvement Plan", "Capacity Development Plans of Farmers' Organizations and the Extension Agencies of the Governments"

① Conduct household survey, marketing survey, farmers' organization survey, training needs assessment of the extension agencies of the governments

② Study cropping plans and water demands in cascade systems for water supply and distribution plan

③ Prepare agriculture and livestock development plan, post-harvest and marketing improvement plan, capacity development plan of farmers' organizations and capacity development plan of the extension agencies of the governments

(5) Implement demonstration activities for cascade water distribution, flood mitigation, rehabilitation and improvement, agriculture/livestock development and livelihood improvement at selected model sites

① Select 5-10 model sites

② Conduct survey at model sites on such as topography, irrigation facilities, farmers' organization, agriculture, socio-economic and soil conditions

③ Prepare water distribution and flood mitigation plan within model sites

④ Prepare standard design of rehabilitation and improvement works

⑤ Implement demonstration activities of improvement and rehabilitation works

⑥ Implement demonstration activities for agriculture/livestock development and livelihood improvement

(6) Prepare "Action Plan" for cascade system development

① Study subsequent necessary projects based on result of (1)-(5)
② Prepare implementation plan for above proposed projects

(7) Environmental and social consideration
① Conduct strategic environmental assessment
② Conduct an environmental and social considerations survey at selected model sites

5. Input
(1) Input by JICA
(a) Dispatch of Mission
- Team Leader / Project Planning
- Hydrology / Irrigation and Water Management
- Irrigation Facility / Rural Infrastructure
- Disaster Management / Soil Conservation
- Crop Production / Extension
- Livestock Production
- Post-harvest / Marketing
- Farmers Organization
- GIS
- Cost Estimation / Construction Supervision
- Environmental and Social Considerations/Conflict prevention

(b) Equipment necessary for the implementation of the Project
(c) Provide training in Japan/ third counties if necessary

Input other than indicated above will be determined through mutual consultations between JICA and MDE during the implementation of the Project, as necessary.

(2) Input by MDE
MDE will take necessary measures to provide at its own expense:
(a) Services of counterpart personnel and administrative personnel as referred to in II-6.;
(b) Suitable office space with necessary equipment;
(c) Supply or replacement of machinery, equipment, instruments, vehicles, tools, spare parts and any other materials necessary for the implementation of the Project other than the equipment provided by JICA;
(d) Information as well as support in obtaining medical service;
(e) Credentials or identification cards;
(f) Available data (including maps and photographs) and information related to the Project;
(g) Expenses necessary for operation and maintenance of the equipment referred to in II-5. (1); and
(h) Necessary facilities to members of the JICA missions for the remittance as well as utilization of the funds introduced into the Democratic Socialist Republic of Sri Lanka from Japan in connection with the implementation of the Project

6. Implementation Structure
The Project organization chart is given in the Appendix 2. The roles and assignments of relevant organizations are as follows:

(1) Administration of the Project
(a) Responsible Organization: MDE
(b) Project Coordinator: Additional Secretary, MDE

(c) Project Manager: Director of Water Resource Management, Department of Irrigation, Ministry of Irrigation

(2) Implementing organizations
- Mahaweli Authority of Sri Lanka, MDE
- Department of Irrigation, Ministry of Irrigation
- Department of Agriculture and Department of Agrarian Development, Ministry of Agriculture
- Department of Animal Production and Health, Ministry of Social Services, Welfare and Livestock Development
- Department of Cooperative Development, Ministry of Food Security
- North Central Provincial Council
- Northern Provincial Council

(3) MDE
(a) Secretary of MDE will be responsible for overall administration and implementation of the Project. He/She will chair the Joint Coordinating Committee (JCC) below.
(b) Additional Secretary of MDE will act as Project coordinator as per stipulated in Appendix 2.

(4) Department of Irrigation
Director of Water Resource Management will act as Head of Project Management Unit (PMU) as per stipulated in Appendix 2

(5) JICA Mission
The JICA mission will give necessary technical guidance, advice and recommendations to MDE and implementing organization on any matters pertaining to the implementation of the Project.

(6) Joint Coordinating Committee
Joint Coordinating Committee (hereinafter referred to as "JCC") will be established in order to facilitate inter-organizational coordination. JCC will be held whenever deems it necessary. A list of proposed members of JCC is shown in the Appendix 3. JCC will meet at least twice a year and whenever necessity arises.

7. Project Site(s) and Beneficiaries
The target area of the Project is included in the area due to development under the NCP Canal Project (NCPCP) in which contained 135 cascades. The area to be benefitted by the Project falls into Anuradhapura and Vavuniya administrative Districts, located in the North Central and Northern Province.

8. Duration
Two years. Tentative schedule of the Project is shown in Appendix 4. The schedule is subject to change when both parties agreed upon any necessity that will arise during the course of the Project.

9. Reports
JICA will prepare and submit the following reports to the MDE in English.
(1) Twenty (20) copies of Inception Report at the commencement of the Project
(2) Twenty (20) of Progress Report (1) at the time about 6 months after the commencement of the Project
(3) Twenty (20) copies of Progress Report (2) at the time of 14 months after the commencement of the Project
(4) Twenty (20) copies of Draft Final Report at the end of the last work period in Sri Lanka.

(5) Twenty (20) copies of Final Report at the end of the Project period.

10. Environmental and Social Considerations
MDE agreed to abide by 'JICA Guidelines for Environmental and Social Considerations (2010) in order to ensure that appropriate considerations will be made for the environmental and social impacts of the Project.

III. UNDERTAKINGS OF MDE AND GOSL

1. MDE and GoSL will take necessary measures to:
   (1) ensure that the technologies and knowledge acquired by the Democratic Socialist Republic of Sri Lanka nationals as a result of Japanese technical cooperation contributes to the economic and social development of the Democratic Socialist Republic of Sri Lanka, and that the knowledge and experience acquired by the personnel of the Democratic Socialist Republic of Sri Lanka from technical training as well as the equipment provided by JICA will be utilized effectively in the implementation of the Project; and

   (2) grant privileges, exemptions and benefits to members of the JICA missions referred to in II-6. (1) above and their families, which are no less favorable than those granted to experts of third countries performing similar missions in the Democratic Socialist Republic of Sri Lanka under the Colombo Plan Technical Cooperation Scheme.

   (3) other privileges, exemptions and benefits will be provided in accordance with the Agreement between the GoJ and the GoSL.

IV. MONITORING AND EVALUATION

JICA will conduct the following evaluations and surveys to mainly verify sustainability and impact of the Project and draw lessons. The MDE is required to provide necessary support for them.

(1) Ex-post evaluation three (3) years after the project completion, in principle
(2) Follow-up surveys on necessity basis

V. PROMOTION OF PUBLIC SUPPORT

For the purpose of promoting support for the Project, MDE will take appropriate measures to make the Project widely known to the people of the Democratic Socialist Republic of Sri Lanka.

VI. MUTUAL CONSULTATION

JICA and MDE will consult each other whenever any major issues arise in the course of Project implementation.

VII. AMENDMENTS

The record of discussions may be amended by the minutes of meetings between JICA and MDE. The minutes of meetings will be signed by authorized persons of each side who may be different from the signers of the record of discussions.

Appendix5

Terms of Reference

Environmental and Social Consideration Study

(1) Conducting the following baseline surveys on environmental and social consideration

- Laws and Regulations on environmental and social consideration, such as environmental impact assessment, pollution control, resettlement, public participation, provision of information to public. Gap analysis between these regal frameworks and "JICA Environmental and Social Consideration Guideline (April, 2010)" will be conducted.
- National and regional organizations which are in charge of environmental and social consideration
- Up dated information of Existing and on-going EIA study results of NCPCP related projects.
- Social environment such as land use, rural communities, poor, ethnic minorities and indigenous peoples, economic and industrial activities in the project area

(2) Analysis on alternatives including zero-option scenario, based on the concept of Strategic Environmental Assessment

(3) Scoping on possible environmental and social impacts, focusing on Air Quality, Water Quality, Wastes, Noise and Vibration, Subsidence, Odor, Protected Areas, Ecosystem, Resettlement, Living and Livelihood, Heritage, Landscape, Ethnic Minorities and Indigenous Peoples, Working Conditions, Impacts during/after Construction.

(4) Environmental Clearance procedure should be taken together with Irrigation Department ,before demonstrating construction works at selected model sites

(5) Evaluation of the impact of the project and the alternatives to the project

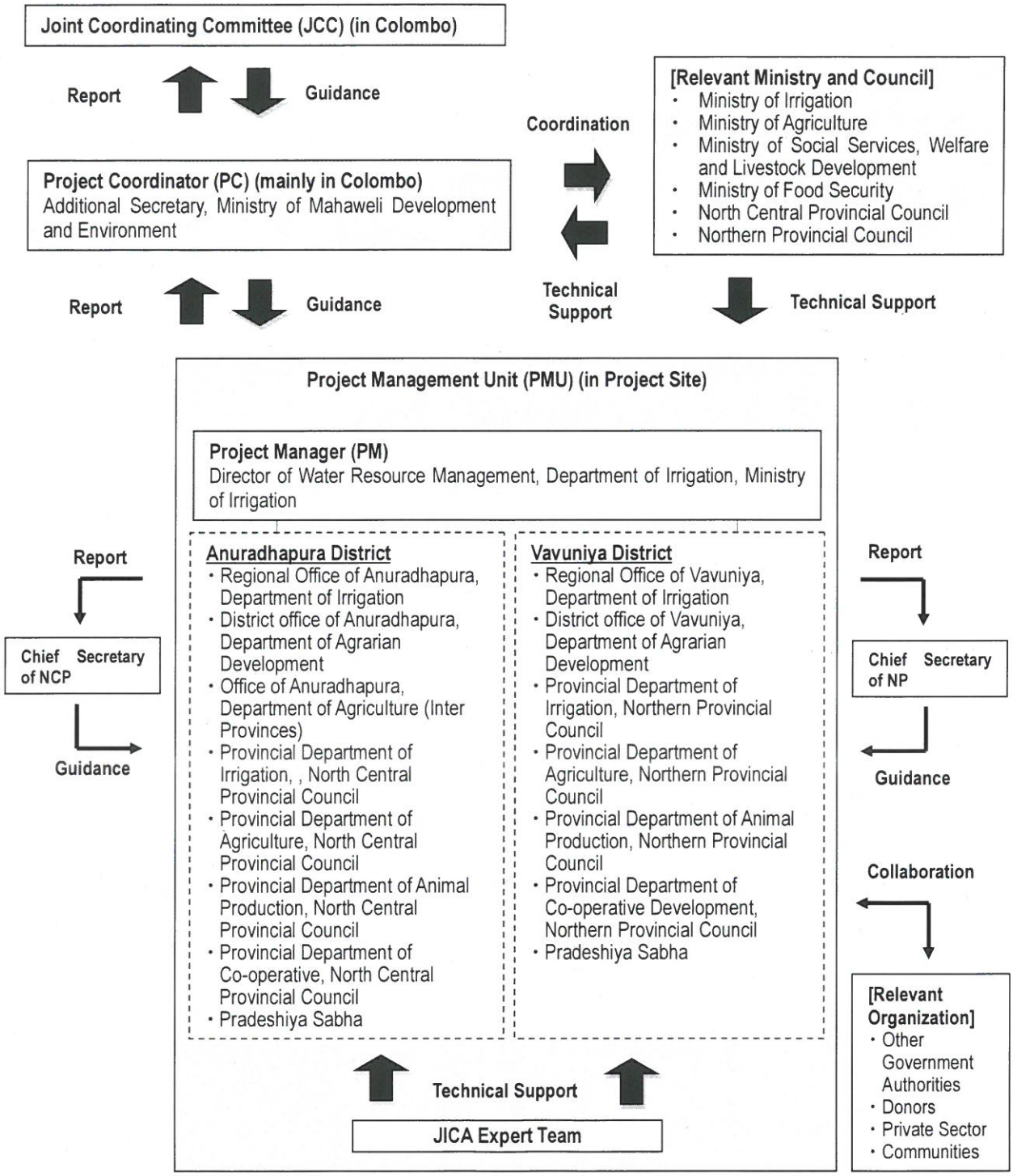
(6) Identifying mitigation measures to minimize the negative impacts of the project

(7) Making monitoring plans for the project

(8) Making recommendations on environmental and social consideration for sustainable Cascade system development

(9) The draft scoping report and the draft environmental and social consideration report to be consulted with local stakeholders, when necessary. Comments to the reports shall be taken into account in the final reports.

Appendix 2 Proposed Project Organization Chart



Function and Role of the Project Organization

- Joint Coordinating Committee (JCC)

Joint Coordinating Committee will be established in order to facilitate inter-organizational coordination and to confirm the reports such as Inception Report, Progress Report, Draft Master Plan and Draft Final Report. JCC will be held whenever deems it necessary. JCC will meet at least twice a year and whenever necessity arises.

- Project Coordinator (PC)

Project Coordinator will facilitate coordination among related Ministries of GoSL and between JCC and PMU, arrange and report to JCC, and make necessary decision for smooth implementation of the activity of PMU.

- Project Management Unit (PMU)

Project Management Unit headed by Project Manager (PM) will implement and monitor the project activities in line with the decision made by the JCC and PC. PMU will report to PC when it necessary. PM will report the project progress periodically to the Chief Secretaries of NCP and NP.

Appendix 3 List of Proposed Members of Joint Coordinating Committee

1. Chairperson
   - Secretary, Ministry of Mahaweli Development and Environment

2. Sri Lankan side
   - Department of Irrigation Ministry of Irrigation
   - Mahaweli Authority of Sri Lanka, Ministry of Mahaweli Development and Environment
   - Department of Agriculture, Ministry of Agriculture
   - Department of Agrarian Development, Ministry of Agriculture
   - Department of Animal Production and Health, Ministry of Social Services, Welfare and Livestock Development
   - Department of Cooperative Development, Ministry of Food Security
   - Department of Forests, Ministry of Mahaweli Development and Environment
   - Department of Wildlife Conservation, Ministry of Sports and Tourism
   - North Central Provincial Council
   - Northern Provincial Council

3. Japanese side
   - Members of JICA mission
   - Representative(s) from JICA Sri Lanka Office
   - Other personnel concerned, to be assigned by JICA, if necessary
   - Official(s) of the Embassy of Japan may attend as observer(s).

4. Other members accepted by the Chairperson, if necessary

Appendix 4 Tentative Work Schedule

	Activities	1st Year		2nd Year		Remark
		1st	2nd	1st	2nd	
1	Review basic water supply plan from NCP canal for cascade systems					
2	Prepare "Rehabilitation and Improvement Plan" for existing cascade irrigation related infrastructure					
3	Prepare "Cascade Operation and Maintenance (O&M) Plan"					
4	Prepare "Agriculture and Livestock Development Plan", "Post-harvest and Marketing Improvement Plan", "Capacity Development Plans of Farmers' Organizations and the Extension Agencies of the Governments"					
5	Implement demonstration activities for cascade water distribution, flood mitigation, rehabilitation and improvement, agriculture/livestock development and livelihood improvement at selected model sites					
6	Prepare "Action Plan" for cascade system development					
	Reports	IC/R	PR/R(1)	PR/R (2)	DF/R	F/R

IC/R: Inception Report
PR/R: Progress Report
DF/R: Draft Final Report
F/R: Final Report
** Above schedule includes the activities which will be done in Japan.*

Appendix5

Terms of Reference

Environmental and Social Consideration Study

(1) Conducting the following baseline surveys on environmental and social consideration

- Laws and Regulations on environmental and social consideration, such as environmental impact assessment, pollution control, resettlement, public participation, provision of information to public. Gap analysis between these regal frameworks and "JICA Environmental and Social Consideration Guideline (April, 2010)" will be conducted.
- National and regional organizations which are in charge of environmental and social consideration
- Up dated information of Existing and on-going EIA study results of NCPCP related projects.
- Social environment such as land use, rural communities, poor, ethnic minorities and indigenous peoples, economic and industrial activities in the project area

(2) Analysis on alternatives including zero-option scenario, based on the concept of Strategic Environmental Assessment

(3) Scoping on possible environmental and social impacts, focusing on Air Quality, Water Quality, Wastes, Noise and Vibration, Subsidence, Odor, Protected Areas, Ecosystem, Resettlement, Living and Livelihood, Heritage, Landscape, Ethnic Minorities and Indigenous Peoples, Working Conditions, Impacts during/after Construction.

(4) Environmental Clearance procedure should be taken together with Irrigation Department ,before demonstrating construction works at selected model sites

(5) Evaluation of the impact of the project and the alternatives to the project

(6) Identifying mitigation measures to minimize the negative impacts of the project

(7) Making monitoring plans for the project

(8) Making recommendations on environmental and social consideration for sustainable Cascade system development

(9) The draft scoping report and the draft environmental and social consideration report to be consulted with local stakeholders, when necessary. Comments to the reports shall be taken into account in the final reports.

ATTACHMENT 2

MINUTES OF MEETING OF JCCs

Minutes of Meeting of the First JCC meeting for
The Project for Formulating Cascade System Development Plan
under North Central Province Canal
In Democratic Socialist Republic of Sri Lanka

Date: 20th June 2016 from 10:30 to 12:00
Venue: Conference room, Ministry of Mahaweli Development and Environment Colombo
Participants: The list of participants of the meeting is attached as Annexure 1.

Agendas:

1. Opening remarks
2. Outline of the project
3. Details of the project
4. Open discussion

Points of discussion

1. Mr. Sisira Kumara, Additional Secretary, Ministry of Mahaweli Development and Environment welcomed and made a brief explanation of the project with purpose of the meeting. The Secretary, Ministry of Mahaweli Development and Environment, made opening remarks.

2. Mr. Lalith De Alwis, Project Manager of the project and Director Water Resources Management, MIWRM briefed on the outline of the project as per attached power point presentation (as per attached as Annexure 2) with the following key points.
   (i). The study has been framed out to prepare Cascade Development plans for 135 cascades focusing on the upgrading of living standard of beneficiaries in the area with the enhancement of water availability under the NCP canal project under Mahaweli Development Programme.
   (ii). Scope of the Work is to study 10 selected cascades to prepare sample cascade development plans aiming at development of irrigation system rehabilitation for effective water management, crop diversification to improve land and water productivity, flood control and disaster management in cascades focusing on climate change variables, social and institutional development, and enhancement of the ecology of the existing systems.
   (iii). Roles of the counterpart staff were clarified to confirm necessary support for the project team

(iv). Project Monitoring and Evaluation mechanism was proposed. It was pointed out, in the presentation, regarding the expected JCC meetings that the frequencies of JCC meetings both at National and provincial level need to be decided.

3. Mr. Asai, Senior Representative of JICA Sri Lanka office requested all the stakeholders to support the consultant team with all the necessary information. He also requested the counterpart organisations to nominate a coordination body with nodal officers from each department for the consultant team to contact with and thorough communication.

4. Mr. Yamaoka, Team Leader of the project team made presentation on the project concepts and approach according to the attached power point presentation (Annexure 3). The key points are as described below.
   (i). The project will apply 4 basic approaches of 1) preparing cascade system-wise effective water utilisation and management plan with principal idea of CASCADE VBA model, 2) inclusion of farmers' organisation based disaster management aspect in the plan, 3) preparing agriculture diversification and management plan aiming at high profitability, and 4) incorporate regional and gender sensitiveness in the development plan.
   (ii). Project phasing was explained as follows; phase 1 from June 2016 to October 2016, and phase 2 from December 2016 to May 2018.
   (iii). Regarding model sites for field tests, the survey team shall decide the number of the model sites, probably between 5 and 10, according to the capacity and needs.
5. Th e points of the discussions in the open discussion session are as follows.
   (i). The Secretary of Ministry of Mahaweli Development and Environment requested to expedite the survey so that the Ministry can prepare budget request for 2018 considering the findings of this M/P study project. Mr. Asai, Senior Representative, JICA Sri Lanka replied it would be difficult to shorten the project period considering the time required for the necessary mobilization and activities, and the implementation schedule has been agreed in the Record of Discussion (RD). Instead, Mr. Asai suggested the project team can share study findings with the Ministry in the form of draft interim report and so forth. The Ministry agreed to notify JICA and the project team of details of the information they need and their timeline, and the project team agreed to consider timing and contents of reports accordingly.
   (ii). Each concerned government department was requested to appoint nodal officers for further communication and coordination specifically for the project.

- Irrigation Department will nominate the officers to be discussed and help the team
- Natural Resource Management Centre (NRMC): Research issues shall be handles at the national level and Agriculture extension shall be don e at provincial office by Regional officers.
- Department of Agriculture and Department of Irrigation, Northern Province appointed a person to coordinate.
- Department of Cooperative, Northern Province will send the name of the person to coordinate.
- Department of Cooperative, North Central province: Assistant commissioner shall coordinate.
- Department of Agrarian Development: Those who attend in this meeting shall coordinate the provincial, and a person at central level was appointed.
- Department of Animal production, Northern Province: The person attending the meeting shall coordinate, and the Assistant Director with his subordinates such as veterinary officers shall assist field works.
- National Planning: Mr. Kimura, JICA Advisor in National Planning Department, shall facilitate meeting with the Director General to discuss appointment of the nodal person and other issues.

The remaining relevant departments shall be informed and be asked to send the name of the appointed officers.

(iii). Comments from each department representative are as follows:

- Irrigation Department basically agreed with the proposal and ready to support. It was requested to include, as well as water management, farmer trainings on cropping, economically feasible cultivation etc.
- Director of Natural Resource Management Centre (NRMC) pointed out that there are many landless people because of the problem of land declaration and those people should be included.
- Northern Provincial Council agreed on taking roles of coordinating provincial level coordination meetings, sharing all the information they have from the past experience with the team.
- Provincial Councils were requested to appoint 1-2 engineers to work fulltime with the team.
- The consultant team was requested to meet provincial governors, Chief Ministers and other political leaders before starting the activities, which shall

be coordinated by the Provincial council. Meetings with the political leaders shall be arranged on 23rd Thursday for North Central, the following Monday on 27th for Northern Province, which shall be confirmed after the meeting.

(iv). Logistic arrangement was agreed that Regional Director of Irrigation will arrange office in Anuradhapura with office equipment, and the office in Colombo shall be arranged by the Central Irrigation Department as well.

(v). The project team and JICA Sri Lanka office clarified that the NCPCP feasibility study funded by ADB is still going on and will take time to provide the final result unlike originally envisaged during R/D negotiation. Under this circumstances the survey is compelled to commence based on currently available result from the Ministry's study and JICA and the consultant team will not be able to revisit or redo the survey responding to the changes made from the feasibility study. The Secretary and Additional Secretary of Ministry of Mahaweli Development and Environment confirmed that since minimum water requirement for the cascade from the NCPCP is already available, the survey can be conducted based on the available information, and if there is any further change in the feasibility study result later on, further survey for amendment shall be made by the GoSL.

(vi). Kick off meeting on 23rd Thursday at 10am for North Central Province shall be arranged with all the relevant department representatives (with chair by the Chief secretary)

(vii). Another meeting in Colombo shall be arranged, as per requirement, in July to discuss the progress and further issues raised.

(viii). The copies of the inception reports shall be distributed and shall receive comments later from each organisation/department. Since the number of hard copies is limited, the soft copy shall be made available by the survey team to those who require it.

Annexure

Annexure 1: Attendance sheet of the meeting

Annexure 2: Power point presentation by the Project Manager

Annexure 3: Power point presentation by the Team Leader of the consultant team

N. A. Sisira Kumara
Additional Secretary
Ministry of Mahaweli Development and Environment

D. D. Ariyaratna
Additional Secretary
Ministry of Irrigation and Water Resources Management

S. A. S. A. De Silva
Director of Natural Resources Management
Department of Agriculture
Ministry of Agriculture

Makato Asai
Senior Representative
Japan International Cooperation Agency
Sri Lanka Office

P. B. Dayaratna
Deputy Chief Secretary Planning
North Central Provincial Council

M. Patrick Diranjan
Secretary
Ministry of Agriculture
Northern Provincial Council

Shigeki Yamaoka
Team Leader
JICA Project Team

Minutes of Meeting of the Second JCC meeting for
The Project for Formulating Cascade System Development Plan
under North Central Province Canal
In Democratic Socialist Republic of Sri Lanka

Date: 10th October 2016 from 9:30 to 12:00
Venue: Conference room, Ministry of Mahaweli Development and Environment Colombo
Participants: The list of participants of the meeting is attached as Annexure 1.

Agendas:

1. Opening remarks
2. Presentation of the project outline (Annexure 2)
3. Presentation of contents of the progress report
4. Open discussion
5. Closing remarks

The 20 sets of the progress report were submitted by the project team and the project team explained the contents of the report with power point presentation materials as attached in Annexure 3. The participants generally approved the progress report made by the project team and followings were discussed in the meeting.

Points of discussion

1. The project team proposed that the target cascade system for this project has been changed from 135 to 128 following to the latest information on "Feasibility study of NCP canal trace to incorporate storage, turnout structures to feed command area cascades, sizing of canal and conceptual development proposal for a selected cascade system in Malwatu Oya Basin (called as FS Report)" prepared by Mahaweli Consultancy Bureau. Although the FS Report said target cascade system was 131 under NCPCP, two cascade systems out of 131 did not exist and one was duplicated. The participants agreed to change the targeted cascade systems under the project as the project team proposed.

2. The concept of the cascade system development proposed by the project team was generally accepted by the participants. However the participants advised the project team to take following points into consideration when the team would proceed to the further study for finalization of the development plan.
    - Even though the government of Sri Lanka has been trying to develop quality

change of agriculture and livestock production for last twenty years, it has faced difficulties. To avoid the same failure in the project, the previous experiences should be taken into consideration in preparation of agriculture development strategy especially in introduction of high quality production and marketing.

- The project should take into account in the planning that deliberate consideration and significant input to change behaviours of farmers is required to realise the modernisation of agriculture with profitable quality agriculture.
- Regarding link canals, both advantages and disadvantages should be taken into consideration. Even though it is understandable to make change and to sacrifice something for modernisation of agriculture, other aspects should be taken into consideration, which include cultural and social issues surrounding the cascade system, precious values of the historical cascade systems, environmental issues and eco systems, and sustainability of the introduced systems. For the implementation as a demonstration, considerable discussions with famers to get concurrence from farmers are required. Application of the link canal system and concept in the Development plan shall be discussed further after demonstration.
- Regarding water measurement system, it should be confirmed to avoid duplication as Water Resource Board is planning to install a similar water measuring system.
- MMDE shall coordinate with UNDP project that targets cascade systems development starting in January 2017.

3. The participants approved the procedure and selection of the model cascade systems made by the project team for the phase-2 activities. The selected model cascade systems are as follows.

District	Cascade No.	Cascade Name	ASC
Anuradhapura	13/MAL4	Ichchan Kulam	Galenbindunuwewa
	7/MA1	Kiulekada Wewa	Kebithigollewa
	5/MAL6	Siyabalagaswewa	Kallanchiya
	4/Y5	Ratmalawewa	Horowpothana
Vavuniya	7MAL8	Alagalla	Kovilkulam/madukanda
	4/PAR2	Neveli Kulam	Omanthai

4. The participants agreed the basic concept and procedure for Phase-2 activities including the detailed planning survey and field program to be implemented in model sites as proposed by project team. The participants also confirmed that the items and the qualities of the activities proposed by the project team were tentative and subject to approval of the JICA Head Office.

(end)

Annexure

Annexure 1: Attendance sheet of the meeting

Annexure 2: Power point presentation of the project outline

Annexure 3: Power point presentation by the Team Leader of the consultant team

For U.R.Seneviratna
Secretary
Ministry of Mahaweli Development and Environment

For Toru KOBAYAKAWA
Senior Representative
Japan International Cooperation Agency
Sri Lanka Office

A.Pathinathan
Chief Secretary
Northern Provincial Council

Eng. S.Weerasingha
Director General of Irrigation

P. B. Dayaratna
Deputy Chief Secretary Planning
North Central Provincial Council

Shigeki Yamaoka
Team Leader
JICA Project Team

Minutes of Meeting of the 3rd JCC meeting for
The Project for Formulating Cascade System Development Plan
under North Central Province Canal
In Democratic Socialist Republic of Sri Lanka

Date: 25th April 2017 from 13:30 to 15:30
Venue: Conference room, Ministry of Mahaweli Development and Environment Colombo
Participants: The list of participants of the meeting is attached as Annexure 1.

Agendas:

1. Opening remarks
2. Presentation of project progress (Annexure 2)
3. Open discussion and approval on the presented progress and plan
4. Closing remarks

Points of discussion

1. Main objective of the meeting is to share progress of the project and plan of implementation for coming months for approval.
2. The Project Team presented progress of the project focusing on the results of detail surveys after brief revision of the project outline. Presented progress and results of detail surveys are attached as Annexure 2 and 3. Further schedule and plans were also presented.
3. Regarding infrastructure rehabilitation, introduction of gate to release water was proposed instead of expanding spillway. The project team replied that expansion of the spillway is more suitable as the objective of the pilot activities is total rehabilitation, which is because introduction of gate is effective if the spillway is in good condition. It was agreed that the implementation of the pilot project is to be proceeded with expansion of spillway, it was requested to include all the options with designs in the development plan so that the government officer who are to implement the project can choose from the presented options depending on the situation.
4. Regarding the risk of blockage of pipeline raised by the participants, the project team explained that a screen system will be introduced to avoid blockage
5. Regarding the selected pilot tanks, it was pointed out that there might be some limitations in terms of facilities and their functions as selected pilot tanks may not represent the general situation, especially for Halmilawewa that is not a tank but a pickup dam. The project team further explained the reasons of selected tanks and it was agreed to proceed with the selected sites for pilot activities.
6. Regarding the four options of link canals, namely open concrete canal, pipeline, contour canal, and mud sluice, proposed to be piloted, the Project team replied that efficiency and effectiveness to increase economic viability is more focused in selection of the link canal designs and applicability shall be evaluated with two different pilot designs of open canal and pipeline.
7. Regarding the question on the future plan of livestock activities as a model in the pilot programme, the project answered that stall feeding and crop-livestock integration will be implemented as a pilot to assess adaptability of those practices with provided fund from the project. It was also mentioned that social adaptability as well as technical adaptability needs to be assessed as people's mind shift is necessary.
8. It was requested to prepare viable models for the coming project to follow during implementation.
9. The participants approved the presented progress and design of the infrastructure facilities to be constructed in the demonstration site and agreed to proceed with the plan.

(end)

Annexure

Annexure 1: Attendance sheet of the meeting
Annexure 2: Power point presentation of the project progress
Annexure 3: Handout of Design for link canal

Udaya R. Seneviratne
Secretary
Ministry of Mahaweli Development
and Environment
No: 500, T. B. Jaya Mawatha,
Colombo-10.

U.R.Seneviratna
Secretary
Ministry of Mahaweli Development and Environment

Toru Kobayakawa
Senior Representative
Japan International Cooperation Agency
Sri Lanka Office

Somasuntharam Shanmugananthan
Deputy Chief Secretary
Northern Provincial Council

S.M.D.L.K De Alwis
Director
Ministry of Irrigation and Water Resources Management

P. B. Dayaratna
Deputy Chief Secretary Planning
North Central Provincial Council

P.B. DAYARATHNE
Deputy Chief Secretary (Planning)
Department of Planning & Monitoring
Office of the Chief Secretary
North Central Province
Anuradhapura.

W.D.D. Prabath
Head of Water Management Division
Department of Agrarian Development /
Water management division

Eng. D. D. Prabath Witharana
(S.L.E.S.)
Head of the Water Management Division
Dept. of Agrarian Development
Colombo - 07.

Shigeki Yamaoka
Team Leader
JICA Project Team

Minutes of Meeting of the Fourth JCC meeting for
The Project for Formulating Cascade System Development Plan
under North Central Province Canal
In Democratic Socialist Republic of Sri Lanka

Date: 9th October 2017 from 14:00 to 17:00
Venue: Auditorium of Ministry of Mahaweli Development and Environment (MMDE), Colombo
Participants: The list of participants of the meeting is attached as Annexure 1.

Agendas:

1. Welcome speech
2. Opening remarks Secretary (MMDE)
3. Self-Introduction by the Participants
4. Progress Presentation by JICA Project Team
5. Discussion Session
6. Closing remarks and vote of Thanks – Project Coordinator (CSDPP)

Progress of the project activities and the major issues of the interim report were presented by the project team as per attached power point presentation. The contents of the interim report presented by the project team were on the whole approved with the following discussions and comments.

Flow of the meeting

1. Mr. Anura Dissanayake , Secretary of Ministry of Mahaweli Development and Environment welcomed and officially opened the meeting. The expected plans to be prepared in the project shall be valuable for future planning of the cascade development. As the emerging climate change is affecting the cropping pattern, a comprehensive plan, including better water management practice with agriculture marketing connection, shall contribute to manage these emerging issues. The government is eagerly expecting the positive findings and valuable plans trough this project.
2. Progress of the project and the outline of the expected output to be prepared in the remaining project period were presented by Mr. Yamaoka, Team leader of the project according to the power point presentation (Annexure 2). The following discussions were made with reference to the presentation.

Points of discussion

1. Secretary commented that the project is driving the current practice to a new dimension of

economic development. These practices shall be achieved through mind change of farmers in water management as well as new crops and marketing. The findings shall be trickled down to the field officers and farmers. Since the completion of the North Central Province Canal (NCPC) is 2024 or after, it is necessary to keep interest of farmers and let them be ready to receive water by developing their mindset as well as infrastructure.

2. Since this is a modernization plan, some innovative practices are proposed to be introduced. It was proposed that any innovative technologies or practices to be introduced should be evaluated through analysing gaps between the existing system and the innovative practice with comparison of advantages and disadvantages, so that the suitable actions can be taken.
3. On the issue of distribution of soil types explained in the presentation, it is not recommendable to rely on literature as some of the figures in the literature are conservative, and there is no updated figure. Therefore, the survey on actual figure will contribute to updating the soil situation for agriculture development. Moreover, it was stated that water quality should be studied as NCPC will definitely bring change on water quality.
4. Regarding institutional development in the field level, it was advised to study profoundly on the underlining agrarian structure, including Bethma system, to interpret them from the perspective of water distribution. Although establishment of Farmers' Organisation (FO) federations for cascade management was already incorporated in the amendment of the Agrarian Development Act, it is a favourable time to propose further legal provision for cascade management if required. Department of Agrarian Development (DAD) is ready to cooperate for any further necessary action as a government.
5. The concern on the ethnic matter in Cascade Management Organization (CMO) establishment was raised as pointed out in the presentation. It was requested to pay considerable attention on the ethnic matter in the planning of cascade management as a cautious matter.
6. In order to establish efficient water use, it was pointed out to introduce accountable system with proper measuring structure. Area capacity curve should be calculated with the proposed excel model to judge efficiency of the water management. Since it is complicated to calculate area capacity curve, it is good to develop simple model to manage it. It was also requested to share collected data as well as data collection methods introduced by the project for the DAD and Provincial Irrigation Department (PID) to process further data. Since the project is collecting supplemental data for what the Irrigation department is working on, cooperation with the Irrigation department is necessary.
7. It was proposed to take further consideration on value chain in the planning as farmers face serious marketing problems. The project shall share more details as the survey has covered more details of marketing related issues.
8. Necessity to consider reservation on institutional structure was reminded as different

9

organisations and authorities are managing different sections of the irrigation systems governed by different ordinances and laws. It was therefore reemphasised to involve those different government bodies in cascade management with explicit responsibilities. For example, in case farmers fail to manage issues such as water master, an alternative backup is necessary to overcome the situation by involving government officers in CMO management. Further details on the CMO management shall be proposed in the action plan.

9. There was clarification regarding necessity of comparatively highly technical irrigation system at the minor tank level with reference to the current practice and situation of major irrigation schemes. Further explanation was requested by one of the officers for feasibility of the proposed complicated monitoring system. Moreover, the feasibility of the system with improved technology to be managed by the community organisations was requested to be verified. In response to these clarifications, the project team leader explained that the plan is to demonstrate an advanced system for efficient use of water by minimizing water loss in this dry zone utilizing precious water from NCPC. The verification programmes were conducted to clarify these issues and it shall be concluded that there is high possibility to apply improved technologies by the time the NCPC is completed in 2024.
10. Importance to adopt these technologies in near future was accepted with condition that farmers acquire capacity to manage those technologies as those minor irrigations are managed by farmers. It was proposed that DAD and PID should coordinate making the most of the advantages of each department by organising joint coordination to establish data collection and utilisation of the data in the field.
11. Facilities built in the pilot projects should be handed over to the beneficiaries with Operation and Maintenance (O&M) guidelines. It was requested to conduct training for operation and management of the rehabilitated facilities before handing over the facilities with help of field officers of DAD, PID.
12. Further concern was raised regarding cascade level management as formation of cascade level management organisation has been discussed for more than 15 years initiated by an international Non Governmental Organisation (NGO) largely in vain. As pointed out in the presentation, there are trans-boundary problems in the cascade level management. Therefore it is necessary to substantiate the situation to make CMO an organisation like the project management committee of the major irrigation.
13. More donors are having interest on cascade development as per seen in the United Nations Development Programme (UNDP) project conducting cascade development activities and forthcoming climate smart initiative of cascade development by World Bank. Government should carefully handle those through effective coordination. The project results shall be valuable for the government to utilise in other initiatives and project as well. DAD can apply

the activities demonstrated through the project in some other cascades to be practiced. Since water distribution is problematic even in the national level water panel, proper feasible water distribution is expected to be established with decent policy through the project.

14. It was also requested to organise a similar meeting at Northern Province as the Chief Minister of Northern Province is expecting the project team to share the progress and ideas as soon as possible.

(end)

Annexure

Annexure 1: Attendance sheet of the meeting

Annexure 2: Power point presentation of the project progress

Anura Dissanayake
Secretary
Ministry of Mahaweli Development and Environment

Secretary
Ministry of Mahaweli Development
and Environment

Toru Kobayakawa
Senior Representative
Japan International Cooperation Agency
Sri Lanka Office

Somasuntharam Shanmugananthan
Deputy Chief Secretary
Northern Provincial Council

Eng.S.Shanmugananthan
Deputy Chief Secretary,
Engineering Services,
Northern Province.

S.M.D.L.K De Alwis
Director
Ministry of Irrigation and Water Resources Management

Eng. S.M. D.L.K. De Alwis
Director (Water Resource Management)
Ministry of Irrigation & Water Resource Management
No. 11, Jawatta Road,
Colombo - 05.

P. B. Dayaratna
Deputy Chief Secretary Planning
North Central Provincial Council

ප්‍රධාන ලේකම් කාර්යාලය
උතුරු මැද පළාත
අනුරාධපුර.

W.D.D. Prabath
Head of Water Management Division
Department of Agrarian Development /
Water management division

Eng. D. D. Prabath Witharana
(S.L.E.S.)
Head of the Water Management Division
Dept. of Agrarian Development
Colombo - 07.

Shigeki Yamaoka
Team Leader
JICA Project Team

Team Leader
" CSDP" Project
No. 03, Irrigation Quarters
Air Port Road
Anuradhapura.

Minutes of Meeting of the Fifth JCC meeting for
The Project for Formulating Cascade System Development Plan
under North Central Province Canal
In Democratic Socialist Republic of Sri Lanka

Date: 28th February 2018 from 15:30 to 18:00
Venue: Auditorium of Ministry of Mahaweli Development and Environment (MMDE), Colombo
Participants: The list of participants of the meeting is attached as Annexure 1.

Agendas:

1. Welcome speech by Secretary MMDE
2. Self introduction
3. Opening remarks by JICA Senior Representative
4. Introduction of the Project activities and study background
5. Presentation on result of the study and proposed plan by JICA Project Team
6. Presentation on importance of cascade development
7. Discussion Session
8. Closing remarks

Flow of the discussion

1. Secretary MMDE welcomed and explained importance of the project with remarks on the further projects following this study, which are to be materialised through proposals from the relevant Departments.

2. JICA Senior Representative, Mr. Kobayakawa made remarks on the project purpose and importance of the meeting to discuss over the Draft Final Report submitted by the project team requesting the participants to evaluate the proposed projects from the view of accomplishing them in the capacity of the concerned departments of the Government of Sri Lanka.

3. Eng. Lalith De Alwis, Project Manager of the project introduced the outline and background of the project with the attached power point presentation. The current situation of the water balance study for Mahaweli Water Security Investment Programme (MWSIP) Phase - 1 supported by Asian Development Bank was reported and it was explained that the JICA study on the cascades was conducted based on the available information of the MWSIP water balance study as per agreed in the 3rd JCC meeting.

4. The project team presented the project study results and proposed projects as well as

recommendations for implementation of the proposed project following the attached power point presentation. Participants were requested to assess the proposed projects especially on the implementation structure of each project.

5. Eng. Prabath Witharana, Head of Water Management, DAD presented importance of cascade development with reference to the attached power point presentation.

6. The secretary opened the discussion referring to the presentation by the project team as well as the presentation on importance of the cascade development in consideration of critical roles of farmers at cascade level.

Points of discussion

1. The secretary pointed out that a part that was not properly addressed is support of local private sectors for financing marginal farmers as well as for marketing of produce as most of farmers do not have credit facilities and have difficulties in marketing.

2. The Deputy Chief Secretary Northern Province commented on the concern on legal arrangement, i.e. whether management/control of the existing system in the Northern Province will be authorised to MMDE once the area is connected to NCPC. Either amending the current Mahaweli Act, or managing those cascade systems within the watershed without leading Mahaweli water through NCPC was requested. Secretary of MMDE mentioned in response to the legal issues that amendment of Agrarian Act for establishment of CMO, which is currently under process, should be completed. Furthermore, it was repeated regarding amendment of Mahaweli Act that central and province should not fight as water is for farmers. During the last decades, water management was addressed by Irrigation Department with some part by province, through which we have never faced water crisis as the system has been functioning well. Therefore, the Secretary proposed to follow the existing water management system of water panel for the benefit of farmers. Concern of the Northern Province that the land might be taken over by MMDE once they receive water from Mahaweli system, was clearly denied by the Secretary MMDE.

3. Other technical suggestion raised as follows.

   a). Catchment development of tanks should be taken into account as many farmers cultivate at the catchment area.

   b). Regarding marketing, scenario will change with NCPC water

   c). More budget should be assured for livestock development as it is one of the important

field.

d). Coordination between different government organisations ("is important."?) DAD and PDI can give a good solution.

e). Central Irrigation Department should be involved properly as medium tanks under control of the Central Irrigation Department are involved in cascade system as well.

4. JICA requested to assess feasibility of the proposed projects by the government organisations assigned as implementing agencies to materialise the projects, as they are responsible for making proposals. Moreover, it was mentioned that coordination is one of the concerns as the projects involve different government organisations. Through the confirmation from each proposed implementing agencies, the proposed implementing structures and the implementing agencies assigned for each project were generally accepted without any significant objection. The comments made by the concerned government offices are as follows.

a). Department of Agriculture (DOA), Department of Agrarian Development (DAD), and Provincial Department of Agriculture (PDOA) are basically able to carry out the proposed activities of the project that they are assigned as the implementing agencies.

b). DOA does not have any problem in working together with FMRC and FMTC for mechanisation, as they have some experiences of cooperation with such organisations in some areas. They also implemented some programmes where farmers established centres from which they can borrow machineries.

c). Regarding Farmers Bank, DAD proposed to apply and develop the Farmers Trust Fund to make agricultural investment fund available for farmers, in consideration of two possible options of increase of fund for agrarian bank and utilisation of farmers trust fund governed by MOA.

d). PDOA are able to handle the activities of proposed projects with its responsibility, as PDOA currently have similar programmes and activities. However some different approaches from their current activities are necessary in capacity building of farmers, as sustainability of farmers groups or organisation is one of their concerns.

e). Concerning involvement of private sectors in the proposed projects, there are some mechanisms for Public Private Partnership (PPP), which the PDOA supports their technical aspects. However, since the department has been facing difficulties in contracting with private sectors, different approaches should be applied for successful collaboration with private sectors, for example applying the experience of farmers' organisations of Japan.

Conclusion of the meeting

Cascade development plans with sector-wise development plans explained by the project team were accepted as a whole. It was agreed that the concerned counterpart offices will send comments on the Draft Final Report distributed by the project team either through Mr. Alwis or directly to the project team by 14th March.

(end)

Annexure

Annexure 1: Attendance sheet of the meeting

Annexure 2: Power point presentation on introduction and background of the project

Annexure 3: Power point presentation of the project study results and proposed projects

Anura Dissanayake
Secretary
Ministry of Mahaweli Development and Environment

Secretary
Ministry of Mahaweli Development
and Environment

Somasuntharam Shanmugananthan
Deputy Chief Secretary
Northern Provincial Council

Eng.S.Shanmuhananthan
Deputy Chief Secretary,
Engineering Services,
Northern Province.

P. B. Dayaratna
Deputy Chief Secretary Planning
North Central Provincial Council

P.B. DAYARATHNE
Deputy Chief Secretary (Planning)
Department of Planning & Monitoring
Office of the Chief Secretary
North Central Province
Anuradhapura.

Shigeki Yamaoka
Team Leader
JICA Project Team

Team Leader
" CSDP" Project
No. 03, Irrigation Quarters
Air Port Road
Anuradhapura.

Toru Kobayakawa
Senior Representative
Japan International Cooperation Agency
Sri Lanka Office

S.M.D.L.K De Alwis
Director
Ministry of Irrigation and Water Resources Management

Eng. S.M.D.L.K. De Alwis
Director (Water Resources Management)
Ministry of Irrigation & Water
Resource Management
No. 11, Jawatta Road,
Colombo - 05

W.D.D. Prabath
Head of Water Management Division
Department of Agrarian Development /
Water management division

Eng. D. D. Prabath Witharana
(S.L.E.S.)
Head of the Water Management Division
Dept. of Agrarian Development
Colombo - 07.

ATTACHMENT 3

LIST OF TARGET CASCADE SYSTEM

Cas_ID	Symbol	Cascade Name	Cas Area (ha)	Basin Name	SWS Name	Total Tanks	Benefit Tanks	Total WSA (ha)	Irrigable Area (ha)
1	9/MAL2	Siwala Kulam	2183.0	Malwathu Oya (Aruvi Aru)	Maminiya Oya	22	1	234.9	55.3
2	11/MAL2	Bora Wewa	308.8	Malwathu Oya (Aruvi Aru)	Maminiya Oya	5	3	44.8	26.6
3	12/MAL2	Pairimaduwa Wewa	520.5	Malwathu Oya (Aruvi Aru)	Maminiya Oya	6	6	47.5	78.9
4	10/MAL2	Galwaduwagama	163.8	Malwathu Oya (Aruvi Aru)	Maminiya Oya	2	2	9.4	20.6
5	12/MAL4	Abagaha Wewa	2261.6	Malwathu Oya (Aruvi Aru)	Upper Kanadara Oya	24	3	347.4	108.3
6	11/MAL4	Periya Kulam	596.5	Malwathu Oya (Aruvi Aru)	Upper Kanadara Oya	6	2	90.7	175.9
7	10/MAL4	Kon Wewa	406.9	Malwathu Oya (Aruvi Aru)	Upper Kanadara Oya	3	2	33.7	102.7
8	9/MAL4	Pahala Halmillewa	515.8	Malwathu Oya (Aruvi Aru)	Upper Kanadara Oya	3	3	45.8	92.9
9	8/MAL4	Tharanogolllawa	95.9	Malwathu Oya (Aruvi Aru)	Upper Kanadara Oya	2	2	25.8	25.6
10	7/MAL4	Siyabalabedigaswewa	174.5	Malwathu Oya (Aruvi Aru)	Upper Kanadara Oya	1	1	6.4	44.1
11	6/MAL4	Mahagal kulam	1274.4	Malwathu Oya (Aruvi Aru)	Upper Kanadara Oya	9	8	138.2	169.5
12	13/MAL4	Ichchan Kulam	1293.5	Malwathu Oya (Aruvi Aru)	Upper Kanadara Oya	9	6	117.5	373.7
13	14/MAL4	Katukaliyawa	914.5	Malwathu Oya (Aruvi Aru)	Upper Kanadara Oya	10	10	87.6	225.5
14	15/MAL4	Kasamaduwa	548.6	Malwathu Oya (Aruvi Aru)	Upper Kanadara Oya	4	4	33.9	115.3
15	16/MAL4	Ittiktiya	331.0	Malwathu Oya (Aruvi Aru)	Upper Kanadara Oya	4	4	34.5	45.9
16	17/MAL4	Galmaduwa	535.8	Malwathu Oya (Aruvi Aru)	Upper Kanadara Oya	5	5	56.0	71.5
17	18/MAL4	Palugas Wewa	2226.0	Malwathu Oya (Aruvi Aru)	Upper Kanadara Oya	20	17	183.2	404.8
18	3/MAL5	Mekechchawa	3181.4	Malwathu Oya (Aruvi Aru)	Upper Weli Oya (Maha Kanadara Oya)	33	29	419.7	800.2
19	2/MAL5	Abagahawela	1097.3	Malwathu Oya (Aruvi Aru)	Upper Weli Oya (Maha Kanadara Oya)	7	7	149.4	164.5
20	1/MAL5	Ethawetuna Wewa	202.1	Malwathu Oya (Aruvi Aru)	Upper Weli Oya (Maha Kanadara Oya)	2	2	15.6	18.1
21	4/MAL5	Ella Wewa	2896.5	Malwathu Oya (Aruvi Aru)	Upper Weli Oya (Maha Kanadara Oya)	18	13	367.1	671.6
22	5/MAL5	Ranpathwila Wewa	3541.9	Malwathu Oya (Aruvi Aru)	Upper Weli Oya (Maha Kanadara Oya)	30	26	670.5	826.0
23	6/MAL5	Kukulawa Wewa	209.1	Malwathu Oya (Aruvi Aru)	Upper Weli Oya (Maha Kanadara Oya)	5	3	36.2	49.1
24	7/MAL5	Konketupothana	653.2	Malwathu Oya (Aruvi Aru)	Upper Weli Oya (Maha Kanadara Oya)	8	8	63.1	120.0
25	8/MAL5	Gekarawa Wewa	624.8	Malwathu Oya (Aruvi Aru)	Upper Weli Oya (Maha Kanadara Oya)	4	4	59.5	79.9
26	8/MAL12	Kongollawewa	754.8	Malwathu Oya (Aruvi Aru)	Lower Weli Oya	8	6	52.9	112.7
27	10/MAL12	Nika Wewa	374.7	Malwathu Oya (Aruvi Aru)	Lower Weli Oya	3	3	31.0	132.7
28	9/MAL12	Mekicha Wewa	247.2	Malwathu Oya (Aruvi Aru)	Lower Weli Oya	2	2	14.8	49.2
29	11/MAL12	Kuda Wewa	689.1	Malwathu Oya (Aruvi Aru)	Lower Weli Oya	3	3	50.1	257.2
30	12/MAL12	Rathmalgaha Wewa	825.9	Malwathu Oya (Aruvi Aru)	Lower Weli Oya	4	4	81.3	215.3
31	13/MAL12	Kudagama Wewa	135.4	Malwathu Oya (Aruvi Aru)	Lower Weli Oya	2	2	15.0	41.7
32	3/MAL6	Tibiri Wewa	2258.3	Malwathu Oya (Aruvi Aru)	Kudahathu Oya	23	21	350.4	390.7
33	2/MAL6	Gonawa Ihala Wewa	404.2	Malwathu Oya (Aruvi Aru)	Kudahathu Oya	3	3	20.8	88.5
34	1/MAL6	Gonawa Wewa	370.2	Malwathu Oya (Aruvi Aru)	Kudahathu Oya	5	3	32.3	61.7
35	4/MAL6	Kapirilgama Wewa	2447.8	Malwathu Oya (Aruvi Aru)	Kudahathu Oya	22	21	326.0	536.5
36	5/MAL6	Siyabalagaswewa	1189.5	Malwathu Oya (Aruvi Aru)	Kudahathu Oya	9	9	180.4	216.4
37	6/MAL6	Thalgaha	949.6	Malwathu Oya (Aruvi Aru)	Kudahathu Oya	6	6	100.4	236.6
38	7/MAL6	Walketu Wewa	325.3	Malwathu Oya (Aruvi Aru)	Kudahathu Oya	4	4	47.0	50.4
39	8/MAL6	Dumminnegama	282.5	Malwathu Oya (Aruvi Aru)	Kudahathu Oya	2	2	39.1	91.0
40	2/MAL7	Lidawewa	345.8	Malwathu Oya (Aruvi Aru)	Sangilikanadara Oya	4	3	37.8	85.7
41	7/MAL7	Pihibiyagollawa	3434.1	Malwathu Oya (Aruvi Aru)	Sangilikanadara Oya	24	24	400.8	724.6
42	6/MAL7	Kirimetiyawa	752.6	Malwathu Oya (Aruvi Aru)	Sangilikanadara Oya	6	6	59.9	110.7
43	5/MAL7	Ralapanawa	823.1	Malwathu Oya (Aruvi Aru)	Sangilikanadara Oya	8	8	54.2	160.7
44	4/MAL7	Kardan Kulam	358.1	Malwathu Oya (Aruvi Aru)	Sangilikanadara Oya	2	2	12.1	72.6
45	3/MAL7	Diulgas Wewa	124.6	Malwathu Oya (Aruvi Aru)	Sangilikanadara Oya	2	2	6.9	20.7
46	8/MAL7	Gagurane Pathaha	2337.7	Malwathu Oya (Aruvi Aru)	Sangilikanadara Oya	9	9	154.1	476.7
47	9/MAL7	Kirigollewa	3774.7	Malwathu Oya (Aruvi Aru)	Sangilikanadara Oya	17	17	148.5	691.0
48	10/MAL7	Kudagama Wewa	3252.1	Malwathu Oya (Aruvi Aru)	Sangilikanadara Oya	15	15	228.1	658.9
49	11/MAL7	Kuda Wewa	614.3	Malwathu Oya (Aruvi Aru)	Sangilikanadara Oya	4	4	36.9	109.2
50	12/MAL7	Madawachchiya Wewa	4956.5	Malwathu Oya (Aruvi Aru)	Sangilikanadara Oya	32	30	401.6	946.1
51	4/MAL8	Parana Halmillewa	3799.6	Malwathu Oya (Aruvi Aru)	Upper Kal ara	21	21	233.4	504.8
52	5/MAL9	Kidewaran Kulam	3598.9	Malwathu Oya (Aruvi Aru)	Boo Oya / Ulukkulama	20	20	313.1	680.6
53	3/MAL8	Thibiri Wewa	311.5	Malwathu Oya (Aruvi Aru)	Upper Kal ara	2	2	25.5	39.6
54	6/MAL8	Dutuwewa	538.7	Malwathu Oya (Aruvi Aru)	Upper Kal ara	1	1	33.1	40.3
55	7/MAL8	Puliyan Kulam	560.6	Malwathu Oya (Aruvi Aru)	Upper Kal ara	5	5	64.2	64.8
56	8/MAL8	Nochchikulam	2150.0	Malwathu Oya (Aruvi Aru)	Upper Kal ara	17	14	237.2	338.5
57	5/MAL8	Aluth Halmillewa	4392.2	Malwathu Oya (Aruvi Aru)	Upper Kal ara	13	12	254.5	472.9
58	9/MAL8	Irataperiya Kulam	3478.7	Malwathu Oya (Aruvi Aru)	Upper Kal ara	22	18	447.3	396.2
59	10/MAL8	Kurundan Kulam	492.4	Malwathu Oya (Aruvi Aru)	Upper Kal ara	4	3	32.3	22.9
60	11/MAL8	Kandapuran Kulam	615.5	Malwathu Oya (Aruvi Aru)	Upper Kal ara	8	3	61.8	91.2
61	12/MAL8	Karuweppan Kulam	1252.2	Malwathu Oya (Aruvi Aru)	Upper Kal ara	15	7	132.6	132.2
62	13/MAL8	Suduventapulavu	686.4	Malwathu Oya (Aruvi Aru)	Upper Kal ara	6	2	53.0	61.4
63	10/Y2	Ihalagal Kulam	601.8	Yan Oya	Huruluwewa	6	2	22.8	31.4
64	9/Y2	Eluwan Kulama	620.7	Yan Oya	Huruluwewa	9	2	54.2	65.2
65	8/Y2	Meegaswewa	389.1	Yan Oya	Huruluwewa	4	3	18.3	138.1
66	7/Y2	Kannimaduwa Wewa	869.5	Yan Oya	Huruluwewa	7	4	81.3	167.7
67	6/Y2	Pahala Nittawa	1144.5	Yan Oya	Huruluwewa	7	2	85.1	133.0
68	5/Y2	Puliyan Kulam	853.6	Yan Oya	Huruluwewa	8	5	51.8	184.8
69	4/Y2	Ella Wewa	388.2	Yan Oya	Huruluwewa	3	3	26.7	48.6
70	3/Y2	Olukolagala Wewa	744.3	Yan Oya	Huruluwewa	5	3	33.5	116.0
71	2/Y2	Punchihammillawa	273.3	Yan Oya	Huruluwewa	2	2	15.9	79.6
72	1/Y2	Mahakirimetiyawa	2198.0	Yan Oya	Huruluwewa	27	21	180.8	463.5
73	7/Y4	Hettuwewa	1035.3	Yan Oya	Mid Yan Oya	6	5	72.7	199.0
74	6/Y4	Kon Wewa	623.9	Yan Oya	Mid Yan Oya	3	3	69.8	189.7
75	5/Y4	Ithalwatuna Wewa	1698.8	Yan Oya	Mid Yan Oya	13	11	158.3	438.9
76	4/Y4	Maha Hammillewa	3400.7	Yan Oya	Mid Yan Oya	32	28	290.2	750.8
77	3/Y4	Moragahadigiliya	3282.3	Yan Oya	Mid Yan Oya	13	12	203.8	591.2
78	2/Y4	Pemorakewa	3783.6	Yan Oya	Mid Yan Oya	27	20	305.7	615.2
79	1/Y4	Patanaya	610.8	Yan Oya	Mid Yan Oya	4	4	23.8	118.9
80	2/Y5	Nilla Wewa	6125.4	Yan Oya	Horowpothana	48	39	453.9	1219.2
81	4/Y5	Rathmala Wewa	1696.4	Yan Oya	Horowpothana	15	14	167.8	366.3
82	1/Y5	Ralapanawa	3307.8	Yan Oya	Horowpothana	23	14	232.3	358.0

Cas_ID	Symbol	Cascade Name	Cas Area (ha)	Basin Name	SWS Name	Total Tanks	Benefit Tanks	Total WSA (ha)	Irrigable Area (ha)
83	1/Y6	Hammillawa	3177.7	Yan Oya	Wahalkada	22	14	171.0	648.8
84	5/Y6	Dutu Wewa	1813.4	Yan Oya	Wahalkada	4	3	154.8	221.2
85	2/Y6	Kapugollewa Ela	3805.0	Yan Oya	Wahalkada	16	8	184.6	600.7
86	3/Y6	Wagollakada	690.9	Yan Oya	Wahalkada	3	3	82.9	99.3
87	9/MA1	Maha Wewalkadawala	3539.0	Ma Oya	Mora Oya	33	30	550.2	697.3
88	10/MA1	Walahawidda Wewa	778.2	Ma Oya	Mora Oya	6	6	78.6	185.3
89	11/MA1	Ulpathagama Wewa	1201.0	Ma Oya	Mora Oya	8	2	116.7	58.0
90	12/MA1	Ulpotha	460.9	Ma Oya	Mora Oya	1	1	8.8	21.2
91	13/MA1	Kiriketu Wewa	337.0	Ma Oya	Mora Oya	2	2	25.4	78.4
92	15/MA1	Mahatikka Wewa	2190.0	Ma Oya	Mora Oya	11	9	112.1	338.6
93	14/MA1	Elapattewa	1098.6	Ma Oya	Mora Oya	8	7	68.1	239.7
94	16/MA1	Gallewa Wewa	929.3	Ma Oya	Mora Oya	7	4	79.8	295.2
95	8/MA1	Ihala Thammennawa	1672.1	Ma Oya	Mora Oya	14	13	153.1	308.9
96	7/MA1	Kiulekada Wewa	1317.0	Ma Oya	Mora Oya	10	10	135.2	292.4
97	6/MA1	Ayiyatige Wewa	4938.5	Ma Oya	Mora Oya	23	22	353.3	929.7
98	5/MA1	Palupuliyam Kulama	698.6	Ma Oya	Mora Oya	8	7	57.7	130.1
99	4/MA1	Ithalwiddawa Wewa	1075.4	Ma Oya	Mora Oya	11	11	57.4	293.3
100	3/MA1	Mahanettiyawa	742.7	Ma Oya	Mora Oya	4	4	41.6	113.3
101	2/MA1	Olugaskada	2008.4	Ma Oya	Mora Oya	11	10	123.1	283.8
102	10/MA2	Sinhaya Ulpotha	541.5	Ma Oya	Mukunu Oya	1	1	4.0	4.0
103	1/MA1	Pahala Herath Mamillewa	388.4	Ma Oya	Mora Oya	2	2	16.2	40.5
104	9/MA2	Medagama Wewa	203.8	Ma Oya	Mukunu Oya	1	1	7.4	10.9
105	7/MA2	Kunchuttuwa	1723.1	Ma Oya	Mukunu Oya	4	3	53.8	165.7
106	8/MA2	Puliyan Kulama	1356.3	Ma Oya	Mukunu Oya	7	7	34.5	116.6
107	6/MA2	Maha Ralapanawa	2082.8	Ma Oya	Mukunu Oya	7	5	74.3	131.4
108	5/MA2	Migakada Wewa	2714.6	Ma Oya	Mukunu Oya	2	2	56.9	98.0
109	2/MA2	Viharahalmillawa	1686.6	Ma Oya	Mukunu Oya	5	2	59.3	38.7
110	1/MA2	Nikawewa	1141.1	Ma Oya	Mukunu Oya	2	1	31.9	19.8
111	5/PAR1	Puthuk Kulam	4315.0	Paranki Aru (Menankddy)	Upper Parangi Aru	21	18	485.4	769.2
112	4/PAR1	Putuk Kulam	899.6	Paranki Aru (Menankddy)	Upper Parangi Aru	7	5	70.0	115.2
113	3/PAR1	Periya Kulam	562.0	Paranki Aru (Menankddy)	Upper Parangi Aru	3	2	49.0	77.8
114	2/PAR1	Kollamutamadu Kulam	1209.2	Paranki Aru (Menankddy)	Upper Parangi Aru	8	5	70.3	116.2
115	1/PAR1	Chinna Kulam	934.3	Paranki Aru (Menankddy)	Upper Parangi Aru	6	6	77.6	102.3
116	6/PAR1	Parandikallu	2750.6	Paranki Aru (Menankddy)	Upper Parangi Aru	25	24	312.3	434.2
117	6/PAR4	Periyakada	4128.6	Paranki Aru (Menankddy)	Periyakattu Aru	18	13	380.4	538.1
118	7/PAR4	Kidachchuri	464.0	Paranki Aru (Menankddy)	Periyakattu Aru	4	4	57.7	70.1
119	8/PAR4	Mullaik Kulam	310.0	Paranki Aru (Menankddy)	Periyakattu Aru	2	2	33.5	26.5
120	7/PAR1	Karunkalisinna Kulam	7048.7	Paranki Aru (Menankddy)	Upper Parangi Aru	15	9	584.5	428.8
121	3/PAR2	Marutan Kulam	2188.3	Paranki Aru (Menankddy)	Thurumpamaddi Aru	13	9	205.7	220.2
122	4/PAR2	Naveli Kulam	1524.0	Paranki Aru (Menankddy)	Thurumpamaddi Aru	12	12	121.9	186.2
123	5/PAR2	Kasawapulaiyan Kulam	351.5	Paranki Aru (Menankddy)	Thurumpamaddi Aru	2	2	24.1	34.8
124	6/PAR2	Alankulam	895.6	Paranki Aru (Menankddy)	Thurumpamaddi Aru	3	3	16.9	43.6
125	7/PAR2	Podun Kulam	718.0	Paranki Aru (Menankddy)	Thurumpamaddi Aru	4	4	38.0	56.8
126	8/PAR2	Palaimoddalk Kulam	500.2	Paranki Aru (Menankddy)	Thurumpamaddi Aru	1	1	29.4	43.5
127	7/MGA1	Chamalan Kulam	5330.5	Kanakarayan Aru	Upper Kanakarayan Aru	10	9	256.8	557.6
128	6/MGA1	Periyapuliyan Kulam	2980.8	Kanakarayan Aru	Upper Kanakarayan Aru	10	10	216.5	400.1
		Total	195,733.4			1254	1013	16,560.1	31,206.5