MYANMAR DRY ZONE DEVELOPMENT PROGRAMME

SCOPING MISSION REPORT

ANNEX 1: SOIL AND WATER MANAGEMENT

ABBREVIATIONS

ADB	Asian Development Bank
ADRA	Adventist Development and Relief Agency
CDZ	Central Dry Zone
DOA	Department of Agriculture
DANIDA	Danish International Development Agency
EIA	Environmental Impact Assessment
ESCAP	Economic and Social Commission for Asia and the Pacific
EU	European Union
FAO	Food and Agricultural Organization
GOM	Government of Myanmar
GRET	Group de Recherche et d'Echanges Technologiques
ID	Irrigation Department
INGO	International Non-Government organization
IWMI	International Water Management Institute
JICA	Japan International Cooperation Agency
LIFT	Livelihoods and Food Security Trust Fund
LUD	Land Use Division
MAS	Myanmar Agriculture Service
MOAI	Ministry of Agriculture and Irrigation
MOLFRD	Ministry of Livestock Fisheries and Rural Development
NGO	Non-Governmental Organisation
O&M	Operation and Maintenance
UNDP	United Nations Development Programme
UNEP-GEF	United Nations Environment Programme – Global Environmental Facility
UNOPS	United Nations Office for Project Services
USAID	United States Agency for International Development
VDC	Village Development Committee
WB	World Bank
WDC	Water Distribution Committee
WFP	World Food Programme
WRUD	Water Resources Utilization Department

SUMMARY

A. STATUS AND SITUATION ANALYSIS

Across the Central Dry Zone (CDZ), water is scarce, vegetation cover is thin, and soils are sandy, degraded and infertile. Annual rainfall ranges from 500 to 1000 mm per annum with high variability and uneven distribution. The wet season lasts from May to October and tends to be bimodal with a lull during July when dry desiccating winds blow from the south. Since the 1970s the wet season has shortened, starting later and ending earlier. Rain events tend to have a shorter duration and increased intensity. The current trends of drought and water scarcity in the Dry Zone are expected to intensify with the effects of climate change. The relatively low and erratic rainfall and the undulating land with mainly infertile sandy and sandy loam soils has led to low agricultural productivity. This combined with exploitation of natural resources through, for example, overgrazing and the cutting of trees for fuel, has led to environmental degradation.

Villages in the CDZ mainly rely on a combination of rainwater ponds, hand dug wells and tubewells for domestic water. About 25% of household suffer water shortages in the dry season, often for several months. Improved water supplies are a high priority in most villages and the most urgent issue to be addressed by the proposed project. An ESCAP study in 1995 found that most groundwater in the CDZ was of low to moderate salinity with a tendency to be sodic. Arsenic may be present in groundwater in some areas.

Other than schemes near the Ayeyarwady and Chindwin rivers, irrigation is relatively uncommon in the townships being considered for the proposed project. Some villages have small surface irrigated areas below reservoirs and a few farmers have invested in wells and pumps to grow onions, tomatoes or other high value vegetables where good quality water and heavier soils exist.

Erosion on cropland does not appear to be a major problem as it is mostly relatively flat or gently sloping and soils are sandy so rainfall infiltrates quickly. Range areas are often steeper with thin vegetation cover and more prone to erosion. An assessment undertaken in Magway district showed that about 76% of land had a low risk erosion, 22% of rangeland, barren land and crop lands on steeper slopes had a medium risk and 2% of land in hilly areas had a high risks.

B. KEY CONSTRAINTS AND OPPORTUNITIES

Domestic water supplies and sanitation. More than 25% of people in the Dry Zone still lack access to a secure source of safe water and to latrines. Ponds for domestic water are the option preferred by most people. The best sites have generally been developed, but there is some scope for new ponds and dams. Many existing ponds need rehabilitation and improvement through increasing the volume, improving bunds and spillways, and reducing seepage.

There is some scope for new hand dug wells. Consideration should be given to providing low cost, locally produced hand pumps for both new and existing wells to avoid the contamination caused by use of dirty containers to draw water. Additional tubewells could be provided in areas where other water sources are inadequate. Despite limited hydrological data the success rate in drilling for water is relatively high. Even if water is salty it can be used for washing and livestock and reduces the volume of water that has to be collected, often from some distance away.

Latrines, guttering and storage tanks for collecting roof water, and water filters could be provided to poorer households. Efforts should be made through community education, perhaps starting with pregnant women and mothers of young children, to develop an understanding of the benefits of clean water and the use of water filters, particularly for pond water.

Irrigation. Poorer villages in the CDZ tend to be those with porous, sandy soils and the least access to water. Poor quality groundwater in wells is a consideration as it may limit the crops that can be grown, and result in saline soils or other soil problems if used for irrigation. Opportunities include provision of canals to small areas of suitable soil below reservoirs, and development of systems based on wells and pumps where lifts are low, water quality is adequate and suitable soils are available.

Soil and water conservation. Tackling soil erosion and land degradation is not a priority in villages, nevertheless, it is important to reduce erosion, to protect infrastructure such as ponds from sediment and to managing water effectively in rainfed agriculture.

C. DEVELOPMENT CONCEPT AND OBJECTIVES

The Component will contribute towards LIFT's objective of improving incomes and food security of the rural poor. Through improving domestic water supplies people's health will be improved and time freed for income earning activities. The development of irrigation for small groups of farmer will raise incomes and improve nutrition. Soil and water conservation measures will help to reduce erosion and runoff, enhancing the productivity of both cropland and rangeland and resilience to climate change, and protect infrastructure such as ponds from sediment. Cash-for-work for construction and rehabilitation of ponds and some soil and water conservation activities will provide a significant injection of cash into the poorest households which will contribute to reduced indebtedness and improved household nutrition during times of food insecurity.

The objective of the Component is to improve the health, food security and incomes of poor rural communities through increasing the availability of water for human and animal consumption, providing irrigation facilities where adequate water and suitable soils exist, and improving soil and water management on both cropland and rangeland.

D. MAJOR ACTIVITIES AND PHASING

The Component will have three sub-components: (1) Domestic water supplies and sanitation; (2) Irrigation; and (3) Soil and water conservation. The collection, collation and analysis of information on groundwater wells in the six proposed Townships and the establishment of a central well database could be initiated under the Programme.

An initial activity will be participatory baseline studies in villages to determine (i) domestic water availability and scope for enhancing supplies; (ii) suitable sites for irrigation development; and (iii) the scope and scale of land degradation and possible interventions. TA will be needed to oversee some activities such as site selection for new ponds, their survey and design, to investigate the quantity and quality of groundwater and its adequacy for irrigation, and for training of DOA extension staff in soil and water conservation techniques.

Domestic water supplies and sanitation. Sites for new ponds will be identified in Year 1 of the project as permits for construction can take a year or more to process. Construction will start in Years 3. Ponds requiring rehabilitation will be identified in Year 1, with implementation starting in Years 2. Works may include increasing the water storage volume, improving bunds and spillways, and reducing seepage. Heavy machinery may be needed, particularly for larger ponds and dams. Improving and protecting the catchment area should be an integral part of implementation. The formation and training of village water maintenance groups is essential.

Implementation of hand dug wells could start in Year 1, as soon as sites have been identified. Where communities are interested, low cost locally produced hand pumps will be provided for both new and old wells. Tubewells will be provided in areas where other water sources are severely limited. Suitable sites will be identified in Year 1 and implementation initiated in Year 2. Testing of all groundwater supplies, for both biological and chemical contaminants, is essential; traces of arsenic have been found in groundwater in some areas. Villages should establish maintenance committees and water charges should cover the cost of fuel and maintenance.

The poorest households will be provided with guttering and storage tanks for harvesting roof water, water filters and latrines. Hygiene education, starting in Year 1, will initially be targeted to pregnant women and those with young children.

Irrigation. Sites with suitable soils for irrigation and adequate water will be identified in Year 1and construction will start Years 2. Both soil and water quality will be tested to ensure that irrigation is sustainable in the long term. Farmers will be encouraged to grow high value vegetables. Canals will be supplied to small areas of suitable soil below larger ponds and reservoirs. An irrigated area of 10-20 acres could be farmed by 20 to 30 households to provide vegetables for household consumption and for sale. Where lifts from wells are low, water quality is adequate and suitable soils are available, pumped systems will be provided to small groups of farmers. A typical irrigation system will include a pumpset, a pump house, a water storage tank, pipes and hosepipes to irrigate about 5 acres, farmed by 5 to 10 households.

Soil and water conservation. Land degradation and other environmental issues will be identified in Year 1 and activities initiated in Years 2. Conservation works directly benefiting individual households will be unpaid, but groups testing new techniques may be provided with incentives such as implements and materials. Cash-for-work will be provide for larger public works. Participative, community based activities will be facilitated to:

- Raise awareness of natural resource issues including land degradation and it's causes;
- Form and train common interest groups to plan individual land and water management activities identified in as priorities by the community;
- Increase productivity and the incomes of farmers through:
    a. the promotion of conservation oriented farming of rainfed croplands;
    b. improved rangeland and pastures;
- Increase the supply of firewood and timber for construction from sustainable sources, thus reducing pressure on rangeland; and
- Reduce accelerated soil erosion and protect assets such as cropland and ponds.

The main emphasis will be on agronomic and vegetative measures which make the best use of water where it falls, increase vegetative cover and generally improve soil structure and water holding capacity. This may include (i) contour planting, strip cropping, relay cropping; (ii) putting

degraded sloping cropland under a permanent cover of fodder grasses and legumes; (iii) Conservation Agriculture (CA) techniques which are characterized by minimum mechanical soil disturbance, maintaining a permanent organic soil cover, and diversified crop rotations; (iv) planting of woodlots/leguminous shrubs for firewood, building materials and fodder. Physical techniques should be limited to those with a relatively low labour requirement and with which farmers and extension staff are familiar, such as contour ploughing, contour earth or stone bunds.

Links to other components and cross-cutting themes. This Component links to Component 2 through provision of water for livestock, small irrigation systems and soil and water conservation activities. Cash-for work for ponds and soil and water conservation activities will benefit the poorest households and has strong links to the cross-cutting themes of social protection and nutrition as it will help to reduced indebtedness and improve household nutrition. Improved domestic water supplies and sanitation will lead to better health. Participatory community activities and group formation and training will be an important element of most interventions.

F. SIGNIFICANT ASSUMPTIONS AND RISKS

Most interventions are not expected to have any significant adverse environmental impact, however, construction of new ponds and dams should be subject to an environmental assessment. There is a danger that providing incentives such as cash-for-work may lead to dependency. Incentives should be used with care and kept to a minimum.

G. INDICATIVE COSTS AND BENEFITS

Indicative costs. At this stage indicative numbers of the different interventions, their phasing and costs are tentative. The total cost of the main interventions is estimated to be USD 4.08 million over a 4 year period. (The cost of TA is not included).

Benefits. The project will target 240 villages in 6 townships and, whilst most of the activities implemented under this component will only be carried out in a portion of the villages, it is likely that all will benefit from some interventions. Better domestic water supplies and sanitation will include improved community hygiene and health and human resources will be freed for more productive activities. The provision of irrigation will increase farmer incomes and improve nutrition. Soil and water conservation measures will help to reduce and repair land degradation, enhancing the productivity of both cropland and rangeland and resilience to climate change. Cash-for-work will provide significant cash to the poorest households which will contribute to reduced indebtedness and improved household nutrition during times of food insecurity.

H. Outstanding Tasks for Design Mission

The most important tasks for the design mission include detailing implementation methods, refining targets and improving cost estimates for proposed activities through discussions with government departments in Nay Phi Taw, and with aid agencies and NGOs in Yangon that have designed and implemented similar interventions. Further information is needed on problem areas such as groundwater quality in the CDZ. Details on the local availability, reliability and cost of equipment and materials needs research (e.g. hand pumps for shallow wells, motorized pumps for irrigation, bentonite for sealing ponds).

A. INTRODUCTION AND METHODOLOGY

1. This Annex was prepared following a scoping missions in Myanmar in January 2014 to assist the preparation of the proposed LIFT-funded Dry Zone Development Programme. It covers the Soil and Water Management aspects of the programme which will be implemented over four years in six Townships of Magway and Mandalay Regions. The scope, activities, tentative costs and potential benefits of the soil and water management aspects of proposed programme are outlined.

2. The findings and recommendations are based on: (a) a review of literature and data; (b) meetings and focus group discussion with a range of key stakeholders, including government officials, donor agencies, and NGO's; (c) discussions with community groups and individual farmers in villages in the proposed Townships and inspection of existing soil and water infrastructure and activities (a map identifying sites visited in Magway and Mandalay is given in Appendix 2).

B. STATUS AND SITUATION ANALYSIS

3. Across the Central Dry Zone (CDZ), water is scarce, vegetation cover is thin, and soils are sandy, degraded and infertile. Annual rainfall ranges from 500 to 1000 mm per annum with high variability and uneven distribution. The wet season lasts from May to October. It tends to be bimodal with a lull during July when dry desiccating winds blow from the south. In the driest part of the CDZ which includes parts of Pakokku, Yesagyo , Myingyan and Taungtha townships the onset of the rains may be delayed until late-June. Since the 1970s the wet season has shortened, starting later and ending earlier. Rain events tend to have a shorter duration and increased intensity.

4. The current trends of drought and water scarcity in the Dry Zone are expected to intensify with the effects of global warming. Water availability is a critical issue and it is anticipated that climate change, in conjunction with increased population, will exacerbate the imbalance between water demand and supply.

5. The relatively low and erratic rainfall and the undulating land with mainly infertile sandy and sandy loam soils has led to low agricultural productivity. This combined with exploitation of natural resources through, for example, overgrazing and the cutting of trees for fuel, has led to environmental degradation.

1. Current situation and trends

Domestic water supplies and sanitation

6. Over the past 20 years, considerable effort has gone into the provision of water for rural communities in Myanmar. It is a high priority of both the government and donors and

significant progress has been made in recent years, but 1 in 4 people in the CDZ still do not have access to a secure source of safe water. A study of 630 households in the Dry Zone by the World Food Programme (WFP) found that 24% experienced domestic water shortages in the dry season[1]. Households mainly rely on a combination of rainwater ponds, hand dug wells and tubewells. Improved water supplies are a high priority in most villages as they experience shortages for several months a year, particularly in the period leading up to the wet season when many ponds and wells are dry. People may then resort to using poorer quality water sources, they may have to pay for tubewell water which increases their poverty or family members may have to spend much of their day collecting water from another village. Improvements to village water supplies is the most urgent issue to be addressed by the programme.

7. An IWMI community survey[2] on water collection and use found that in villages with only rainfed crops on average each household collected 60 to 80 gallons of water per day (≈ 270 to 360 l/day). Approximately 15% to 20% of the water collected was allocated for drinking purposes, about 50% for other domestic uses and 30% to 41% for watering livestock. The relative proportions allocated did not appear to change significantly between seasons or during drought periods for the different households groups (i.e. marginal and landless farmers).

8. Over the past two decades, the government and other agencies have constructed and rehabilitated many reservoirs and ponds. However, they are often poorly sited and fail to capture much runoff. Some are located on soils that are sandy and gravelly so water seeps out almost as fast as it flows in. No lining is provided and, even where soils are suitable, compaction is not carried out. Where the pond or reservoir site is good and the soils hold water, spillways may be poorly located or non-existent leading to overtopping and erosion of embankments in periods of heavy rain. Ponds are usually assigned just for domestic water or for livestock use, not for both. Animals are kept away from the ponds allocated for domestic use, but in times of water shortage water may be taken from the domestic ponds to the animals. Village ponds are usually managed by the community but, particularly in the case of larger ponds and reservoirs, may be managed by the Irrigation Division (ID) or by the ID together with the community.

9. Most villages have at least one tubewells generally provided by the government or, less often, by aid agencies or NGOs. These are from 100 to 500 feet deep and water has to be pumped. Village maintenance committees operate and maintain the wells, engines and pumps, and users pay a fee for the water. Often the tubewells are only used towards the end of the dry season when other sources have dried up as villagers find even the relatively small charges a burden and they prefer the taste of pond water. In many villages the water is salty and is used only for washing and livestock. In villages where groundwater is good quality there are often a number of privately owned tubewells.

10. Hand dug wells, from 10 to 60 feet deep, are common throughout the area. Often they are located beneath the bunds of pond or reservoirs, or sometimes actually in the beds of shallow ponds. They tend to be less saline than tubewells but often dry up towards the end of the dry season. Pumps are not common and buckets are generally used to draw water.

[1] WFP (2011) Food security assessment in the dry zone Myanmar.
[2] IWMI (2013) Community Survey on Water Access, Availability and Management Issues in the Dry Zone of Myanmar: Final Report for Component 2

11. INGOs such as ADRA consider salinity to be a problem for tubewell development in parts of the Dry Zone. A 1995 study by ESCAP1 characterized the groundwater in the Dry Zone as of low to moderate salinity (typically 1000-2000 μS/cm) and mainly of a sodium bicarbonate type. Accurate data on the locations, depths, extent and quality of aquifers is sparse.

12. In 2013 the International Water Management Institute (IWMI) carried out a study of water resources in the CDZ on behalf of LIFT[2]. One recommendation from the study was that to avoid the risk of over-extraction of water in the CDZ, particularly for irrigation, past groundwater surveys need to be completed and updated using modern remote sensing and GIS techniques to provide detailed hydrogeological and hydrochemical maps. Another IWMI recommendation was the establishment of a database of groundwater wells (location, monitoring of groundwater levels, water quality), building on data held in local WRUD offices. In particular further work is needed to determine the extent and prevalence of arsenic in groundwater. Arsenic presents a potentially major threat to public health. It is a particular hazard in the Ayeyarwady Delta but studies by WRUD indicate that there is a low risk in the CDZ of arsenic exceeding the WHO drinking water guideline value of 10 μg/l. IWMI also suggested undertaking a structured survey of well-drilling companies and individuals to capture informal local knowledge of the location, extent and reliability of groundwater resources.

13. Roof rainwater catchment and storage is relatively common. Gutters, downpipes and concrete storage tanks with capacities of 1000 to 2000 gallons are mostly self-financed. The houses of poorer households tend to be thatched and unsuitable for collecting rainwater and, even where houses have corrugated iron roofs, families often cannot afford a storage tank.

14. UN-Habitat has supplies large numbers of household sand filters to families in the CDZ. Training was provided in their use, nevertheless, few people consider them necessary and most have been emptied of sand and are being used as storage containers or waste bins.

15. Latrines are common in all villages but many poorer families cannot afford them. In some villages agencies provided the pits and squatting plates but left householders to fund and build the sheds above. Some poorer families were unable to afford the wood needed for the frame and door. It is estimated that about 25% of households lack access to a latrine.

Irrigation

16. Irrigation has been a high priority of the government since the 1980s. Schemes are mainly gravity fed from weirs or dams, or pumped from rivers. Groundwater irrigation accounts for about 5% of the total. The performance of formal irrigation schemes has been sub-optimal, with actual areas irrigated much lower than nominal command areas. A government report released by the Auditor General's Office in 2012, found that "Sixty-seven river water pumping stations have achieved 16.3% of their target, providing water to 48,833 acres out of the 299,895 acres originally planned", and that some reservoirs and diversion dams could not supply water at all. This is attributed to a wide range of issues including system design, operation and maintenance issues, availability of power for pumping, and inappropriate siting and soils. Many systems were designed to grow rice under flood conditions, and are insufficiently flexible for other crops; and there is a lack of extension of agronomic advice to assist farmers to make best

[1] ESCAP (1995) Assessment of water resources and water demand by user sectors in Myanmar
[2] IWMI (2013) Water Resource Assessment of the Dry Zone of Myanmar: Final Reports

use of irrigation. These issues are compounded by inadequate funding and technical capacity for operation and maintenance.[1]

17. Other than schemes near the Ayeyarwady and Chindwin rivers, irrigation is relatively uncommon in the townships being considered for the proposed project. Some villages have small surface irrigated areas below reservoirs if sufficient water and suitable soils are available. In a few cases individual farmers have invested in wells and pumps to grow onions, tomatoes or other high value vegetables where good quality water and heavier soils exist. Lifting is performed by small-scale motorized pumps (<12 HP) that operate effectively where the water level in the well is within about 6-8 m of the ground surface. Very shallow wells are sometimes dug in depressions or riverbed and buckets used to water small areas of vegetables.

Soil and Water Conservation

18. The main causes of land degradation in the CDZ include deforestation, poor agricultural practices, overgrazing and shifting cultivation, all of which are exacerbated by the increasing population.

19. In the proposed project townships particularly heavy rainfall no doubt leads to some sheet and rill erosion on cropland, but it does not appear to be a major problem as most cropland is relatively flat or gently sloping and soils are sandy so rainfall infiltrates quickly. Wind erosion occurs, particularly when soils are bare after land preparation. Soil and water conservation measures are already used by some farmers, particularly contour ploughing and contour earth and stone bunds on steeper slopes. Bunding of heavier soils is practiced to retain water for monsoon rice. The range areas where livestock are grazed are often steeper with thin vegetation cover and may be subject to erosion. A soil erosion risk assessment undertaken in Magway district[2] showed that about 76% of the land had a relatively low erosion risk, 22% of rangeland, barren land and agricultural lands on steeper slopes had a medium erosion risk and 2% of land in hilly and mountainous areas had a high erosion risk.

20. Villagers are heavily dependent on products from the rangeland, especially fuelwood, poles and fodder, which has led to deforestation, land degradation and increased erosion. They often recognise that wind and water erosion are occurring on their land but do not know what to do about it. Gullies occur in some areas but do not appear to be a widespread problem in the proposed project townships.

2. Key policies and stakeholders

21. Provision of safe water for communities is a high priority of government, international donors and NGOs. The Myanmar Water Vision, formulated in 2003, states that "By the year 2030, the country will have an attainment of sustainability of water resources to ensure sufficient water quantity of acceptable quality to meet the needs of people of country in terms of health, food security, economy and environment". The Myanmar Water Resources Committee (MWRC), was established by the Government in 2005 as a national apex body to implement the

[1] IWMI (2013) Identifying Priority Investments in Water in Myanmar Myanmar's Dry Zone: Final Report for Component 3.
[2] Zaw Wan and Chanchai Sangchyoswat (2008) Soil Erosion Risk Assessment Using GIS and Farmer's Perception: A Case Study in Dry Zone Area of Central Region of Myanmar,

Myanmar water vision. Its responsibilities include developing policies, guidelines, laws and regulations.

22. Responsibility for rural water supplies is shared between the Water Resource Utilization Department (WRUD) of the Ministry for Agriculture and Irrigation (MOAI), the Department of Rural Development (DRD) in the Ministry of Livestock, Fisheries and Rural Development[1] and the Environmental Sanitation Department under the Ministry of Health. In addition, the Irrigation Division of MOAI constructs some small dams for domestic water in the CDZ.

23. Agencies such as UNICEF, UNDP, UN-Habitat and WHO, have worked with the government on provision of water and sanitation since the 1970s. NGOs, both local and international, are also active in the water supply sector. The MIMU database listed 12 such organisations working in the areas of safe water supply and construction and rehabilitation of water facilities in the Dry Zone in 2012, working in more than 465 villages.

24. The government has prioritized irrigation since the 1980s, with a major program of construction and irrigation development. In 2000, the government set a national target to make irrigation available for 25% of agricultural land, with an emphasis on irrigation of summer paddy. Until recently the government mandated production of paddy on irrigated land which hampered the ability of farmers to make the best use of available water. This policy is no longer enforced. Responsibility for agricultural water supply lies with the MOIA. It is split between the Irrigation Department (ID) which covers surface water storages (dams and weirs) and large canal command gravity fed irrigation schemes, and the WRUD which covers pumped irrigation projects, groundwater irrigation and spate irrigation systems. Most large schemes are funded by government, with some support provided by FAO. Some donors and NGOs have included irrigation as a component of broadly based livelihood programmes.

25. The Land Use Division of the Myanmar Agriculture Service (MAS) is responsible for land use planning and soil conservation. MAS is the umbrella organization of MOAI that coordinates agricultural research and extension throughout the country.

26. Dry Zone Greening Department (DZGD) of the Ministry of Forestry, in addition to forestry activities, undertakes water resources development and soil conservation activities including construction of small ponds to supply water for trees, people and animals, sinking of tube-wells to supply water for nurseries, plantations and community use, construction of check dams to reduce run-off and erosion, and construction of rain-water collection tanks in public places such as village schools.

27. In 2002 the National Commission of Environmental Affairs (NCEA) compiled a National Action Plan to Combat Desertification[2]. UNDP and FAO have been active in soil and water conservation programmes in the CDZ in recent years.

3. Soil and water management initiatives

[1] Previously under the Ministry of Progress of Border Areas, National Races and Development Affairs

[2] NCEA, 2005, Myanmar National Environmental Performance Assessment and Subregional Strategic Environment Framework for the Greater Mekong Subregion. ADB TA No. 60069-REG

28. In 2003 WRUD reported 13,804 completed projects in Magway, Mandalay and Sagaing providing water for 6.86 million people. This included provision of piped and gravity-fed community water supplies, but the main focus was the construction of more than 13,700 deep and shallow wells for village use.

29. From 2000 to 2010 DRD implemented a rural water supply project through development committees in Sagaing, Magway and Mandalay Divisions with JICA assistance under the project "Rural Water Supply Technology in the Central Dry Zone", which aimed to construct and rehabilitate village tube wells, while strengthening the capacity of DRD in water supply technologies. In parallel with this initiative Bridge Asia Japan completed construction and rehabilitation of water facilities in 166 villages in Magway and Mandalay in 2012.

30. The UNDP Human Development Initiative Integrated Community Development Program and the UN Human Settlements Program "Shae Tot" have supported provision of water supplies to over 1,700 villages in the Dry Zone.

31. NGO projects cover a range of approaches to water provision, including deep tubewells for drinking water (eg JICA, Bridge Asia Japan); construction and renovation of multi-use village ponds (ADRA, Proximity, Solidarity International, ActionAid and others); piped village water supplies and rainwater collection tanks (ADRA); affordable pumping technologies (Proximity).

32. The ID has a fleet of equipment and trained staff for construction of rainwater harvesting ponds and dams. In 2012 in Mandalay Region the ID implemented 200 water storage ponds and reservoirs. This included renovation and reconstruction of old works as well as construction of new water storage structures for irrigation and domestic water uses. Cyclone Giri in 2010 destroyed a large number of ponds and dams in both the Mandalay and Magway regions as they were not built to withstand extreme rain events.

33. In the CDZ most government and donor irrigation activities have been centred on relatively large surface and pumped schemes for growing paddy.

34. In addition to government watershed management activities in the CDZ such as widespread reforestation programmes, UNDP and FAO have introduced integrated soil conservation and water harvesting measures in some areas in order to restore fragile ecosystems. This included community forestry programmes and the promotion of energy-saving household stoves.

B. KEY CONSTRAINTS AND OPPORTUNITIES

Domestic water supplies and sanitation.

35. While recent progress has been impressive, more than 1 in 4 people in the Dry Zone still lack access to a secure source of safe water and to latrines. Lessons from past programs include:

- Maintenance and desilting of ponds at least every 2 to 3 years is critical to maintain viable volumes. NGOs working in the Dry Zone report that regular maintenance is often neglected, which means that more expensive and difficult renovation is then needed.
- Because the hydrogeology of the area is poorly understood, siting of wells is largely exploratory and yield and water quality cannot be assured before drilling. Villages often have some wells with good quality water and others that are salty. In some cases wells have gradually become more salty over several years. More than 60% of villages visited by the mission reported salty water in some of their wells.
- Many existing rural water supply tubewells are in poor condition or not functioning. This may be due to poor siting and construction, lack of trained villagers for operation and maintenance, salty water, or people being reluctant to pay for water where other water sources such as ponds are available free. In some villages tubewells are only used towards the end of the dry season when other sources dry up.
- A critical lesson from current programs is the importance of embedding water into broader village livelihood strategies, taking account of the full range of needs and users. ActionAid and ADRA have developed participatory methods for working with communities to ensure that water interventions are closely linked into village development plans, with clear delineation of responsibilities for construction, operation and maintenance.
- Sand filters were distributed by UN-Habitat to households in many villages but most remain unused despite some training being provided.
- Most villages have some latrines. Generally aid agencies provided the pit and squatting slab leaving households to build the shed, but the poorest households sometimes cannot afford the wood needed for the frame and the door so the latrine remains unused.

36. **Ponds / reservoirs**. Ponds and small dams for domestic water are the option preferred by most people in the project area. The best sites have generally been developed but there is some scope for new ponds and dams. There are many existing ponds and reservoirs in need of rehabilitation and improvement. This could include increasing the volume, improving bunds and spillways, lining sandy storage areas with clay if it is available nearby, investigating other possible methods of reducing seepage such as the use of flexible membranes or bentonite[1] and improving/protecting the water catchment area. Care must be taken when deepening some older ponds as over time organic matter and silt collects creating a seal that reduces permeability and seepage losses. Breaking the seal may be counterproductive.

37. Communities have many of the skills needed to both construct and maintain ponds and reservoirs, but support is needed in the form of technical advice, community payments for labour, or access to machinery. A key issue is good spillway design and maintenance. Many small dams fail because they are overtopped in a flood, often because there is no spillway, the spillway is inadequate or spillway maintenance has been neglected (Cyclone Giri in 2010 destroyed many ponds and dams in the CDZ). Consultation with the community as to design, construction and maintenance requirements and responsibilities is critical. Maintenance such as silt removal and repair of walls is required at least every 2-3 years and, in many cases, annually. Unless the community commits to maintenance the investment will be lost. INGOs such as Solidarity

[1] Bentonite is a clay with a high shrink-swell ratio. It is sold in powder form and can be mixed with existing soils and compacted in layers. Upon wetting, the bentonite will swell to many times its dry volume and seal soils that lack clay-size particles. It is produced and sold in Myanmar.

International and Proximity have set up water management groups in villages for this purpose. In 2011 Solidarity International established water management groups in 15 villages in the Dry Zone. It adopts a number of mechanisms to ensure that the groups remain active once they leave the area.

38. The type, design and siting of water storage infrastructure is site specific and technical support is important to identify suitable soil types, locations and designs. The following figures and calculations are very rough but give a guide to the type of considerations in design. Seepage and evaporation losses from ponds and reservoirs may be 3-4m per year, therefore to provide water year round they should ideally be able to collect and store a minimum depth of 5m of water. Annual rainfall in much of the area is only 500-600 mm so most of the water has to come from catchment runoff. Only a fraction of the rainfall on the catchment will runoff and reach the pond and so a catchment of several hectares will be needed. For example, if a 100m x 50m x 5m pond receives 0.5m rainfall, then 4.5m of water has to come from runoff. This gives 100m x 50m x 4.5m = 22,500m^3 to come from runoff. Assuming that only 20% of rainfall (0.1m) falling on the catchment reaches the pond, a hectare supplies 0.1m x 10,000m^2 = 1,000m^3. Therefore, a catchment area of 22,500 m^3/1,000 m^3 = 22.5 ha would be needed to fill the pond.

39. **Hand dug wells**. There is some scope for new hand dug wells up to 30 feet deep. The community should be responsible for digging the well and assistance provided towards the cost of lining and providing a concrete apron around wells. Consideration should be given to providing low cost, locally produced hand pumps for both new and existing wells to avoid the contamination caused by use of dirty containers to draw water.

40. **Tubewells**. Most villages have at least one tubewell but additional tubewells and storage tanks should be provided in areas where other water sources are inadequate for part of the year. Despite limited hydrological data the success rate in drilling for water is relatively high. In some cases existing tubewells could be rehabilitated. Even where water is salty it can be used for washing and livestock and reduces the volume of water that has to be collected, often from some distance away, to simply that needed for drinking and cooking. The community should be responsible for providing unskilled labour.

41. **Roof water collection and storage**. This is common in the CDZ but usually self-financed so confined to the houses of the better off. Guttering, downpipes and a storage tank could be provided to poorer households. In the case of poor families with thatched roofs, the provision of corrugated iron sheets should be considered.

42. **Sanitation**. Assistance with latrines should be targeted to poorer households only. Families should be provide a squatting plate, pit and the wood for the shed frame and a door. They should provide the woven basket covers for the sides of the shed and thatch the roof.

43. **Hygiene education and water filters**. The aim of providing water and latrines is to improve the health and quality of life of a community. Technical developments or improvements will give maximum benefits only if they are part of a wider hygiene education programme. This may involve changing long held attitudes and practices and may well take considerably longer to achieve than the actual construction work. Hygiene education tends to be concentrated on women, but it is often children who are the easiest to educate regarding the benefits, and then they insist on changes being made within the family unit. UN-Habitat distributed household sand filters for water treatment widely in the CDZ. Few people see the need for them and most are not used.

Efforts should be made through community education, perhaps starting with pregnant women and mothers of young children, to develop an understanding of the benefits of clean water and the use of water filters (particularly for pond water). Low cost, locally made ceramic water filters could be provided to poor families with young children or assistance given to renovate the UN-Habitat sand filters. Maintenance and cleaning of latrines and water filters and containers should be included in training.

Irrigation

44. The poorer villages in the CDZ tend to be those with the least access to water. It is essential that domestic water needs are met before water is taken for irrigation[1]. Water quality is also a consideration. In 60% of villages visited by the mission some of the wells were described as salty. The groundwater in the Dry Zone is typified as of low to moderate salinity and with a tendency to be sodic. It may limit the crops that can be grown to those that are salt tolerant and, without adequate leaching, will result in saline soils. Irrigation of heavier soils with sodic water may result in drainage problems and crusting which can affect crop growth and yields.

45. Lack of water, salty water in many areas and sandy soils limit the scope for irrigation but interventions may include:

- Provision of canals or piped water to small areas of suitable soil below larger ponds and reservoirs with adequate year round water. In some cases it may be possible to pump from ponds to irrigate adjacent areas.
- Provision of wells and pumps where lifts are low, water quality is adequate and suitable soils are available.

46. Irrigation systems should only be provided to groups of farmers and they should provide all the labour for construction. They should be trained in operation and maintenance of the system. Pumped irrigation is most likely to be viable for high value crops such as vegetables. Farmers should be assisted to access good quality seed and inputs and provided with guidance on how to ameliorate the effects of poor quality water through, for example, leaching and the use of gypsum. A likely difficulty is that, as the heavier soils are better for agriculture, the command area is already farmed by individual households and a way will have to be found to compensate them to allow more farmers to share the land and benefits of irrigation.

47. Data on groundwater and wells in the CDZ is sparse. Detailed hydrogeological and hydrochemical maps are needed to avoid the risk of over-extraction of groundwater particularly for irrigation. Past groundwater surveys need to be completed and updated and a database of groundwater wells established to provide information on their location, water quality and groundwater levels.

Soil and water conservation

48. In villages visited by the mission people often acknowledged that they were aware of soil erosion and other environmental issues but said they did not know what to do about it.

[1] A 1 ha dry season vegetable crop is likely to need a minimum of 4,000 - 5,000 m^3 of water, or more if leaching is required.

Tackling soil erosion and land degradation was not raised as a problem or a priority. Some people complained about the high cost of firewood, however.

49. Soil and water conservation is important to reduce and repair land degradation, to protect infrastructure such as reservoirs and ponds from sediment and to managing water effectively in rainfed systems at both field and watershed levels. The aim should be to slow the movement of water through the landscape, to enhance infiltration and availability of water, and reduce erosion. At farm level, agricultural extension programmes should provide information and training on soil and water conservation techniques. At village level, watershed management should form an essential component of pond construction and rehabilitation, with cash-for-work opportunities for villagers.

50. **Physical techniques**. There has been a general move away from many of the physical conservation techniques, which may be effective in controlling runoff and erosion but often do little to increase production or incomes. For conservation measures to succeed they must be seen by farmers as a means of attaining increased production in a sustainable way, not just as a means of controlling erosion. In drier areas such as the CDZ, however, where it is more difficult to implement vegetative methods, physical methods may be needed to help plants to become established and cover the ground quickly. Techniques should be limited to those with a relatively low labour requirement such as contour ploughing, contour earth or stone bunds, and "trash lines" formed from the residues of past crops. Since farmers and extension staff in the CDZ are already familiar with these techniques they could be supported under the project. In addition, micro-catchments for tree planting and contour ridges stabilised with napier, vetiver or other perennial grasses may be appropriate in some areas. Although gullies are amongst the most noticeable forms of erosion, studies in other countries have shown that their contribution to the overall erosion rate tends to be relatively small, with more serious soil loss being caused by sheet and rill erosion on arable land and overgrazed pasture. Where a gully is threatening a valuable asset such as cropland or a ponds, it may be necessary to stabilize the gully head by diverting storm water away to a safe discharge point, construct cheap check structures in the gully that will last long enough to allow silt to collect and vegetation to become established, and protect the area from livestock.

51. **Agronomic and vegetative measures.** The main emphasis should be on promoting biological conservation and moisture retention techniques which make the best use of water where it falls, increase vegetative cover and generally improve soil structure and water holding capacity. These may include:

- Measures such as contour planting, strip cropping, relay cropping;
- Putting degraded sloping cropland under a permanent cover of fodder grasses and legumes;
- Conservation Agriculture (CA) techniques which are characterized by three inter-linked principles: (i) minimum mechanical soil disturbance, (ii) maintaining a permanent organic soil cover, and (iii) diversified crop rotations and associations. As people in the project areas are not familiar with some of these techniques considerable effort would need to be put into training of both farmers and extension staff. On-farm tests and demonstrations would be a key component. Incentives in the form of implements such as jab planters and ox drawn rippers or direct planters could be provided to groups of interested farmers to assist planting through crop residues. (See Annex 2: Seed, Crops and Livestock Component for further details.)

- Planting of woodlots/leguminous shrubs for firewood, building materials and fodder. Fuel wood and building poles are in short supply and expensive in many villages, however, community woodlots have a chequered record. Small tree nurseries (perhaps one nursery serving 3 or 4 villages) will be needed, the seedlings will have to be planted on communal land, protected from livestock and watered through the first dry season. They are only likely to be successful where villagers are interested, water is available nearby and incentives are provided. Individuals or schools could be provided with materials and tools to set up tree nurseries and the project could then buy the seedlings for planting in the woodlot. There may also be a market amongst villagers for tree seedlings, particularly fruit tree, for planting around homes and field boundaries which would help to make a nursery sustainable. Cash-for-work may be needed for planting seedlings in the woodlot and to ensure that they are watered through the first dry season.

52. **Incentives:** A regulatory approach to conservation is generally ineffective - farmers are more likely to respond to incentives and technical assistance. Incentives provided by aid agencies have often been counterproductive with a slow pace of work, follow-up maintenance neglected and, in some cases, conservation works constructed but then not used. Nevertheless, careful use of incentives is essential to encourage villagers to participate in conservation activities. These should be kept to a minimum and only used for works benefiting the community as a whole such as the planting of trees, for community groups testing new techniques, and for conservation measures on public land. They should be in the form of the provision of materials and tools, funding of transport or equipment hire, and payment for a portion of the labour involved. Where cash-for-work is used, every effort should be made to employ the poorest members of a community.

C. DEVELOPMENT CONCEPT AND OBJECTIVES

1. Development concept

53. The Soil and Water Component will contribute towards LIFT's objective of improving incomes and food security of the rural poor. Through increasing the availability of domestic water supplies, which is a priority in most communities, the component will improve people's health and reduce the amount of time spent on collecting water thus freeing time for income earning activities. Where adequate water and suitable soils are available, the development of irrigation for small groups of farmer will raise incomes and improve nutrition through increasing the availability of vegetables. Soil and water conservation measures will help to reduce erosion and runoff in rainfed cropland and surrounding rangeland, protect infrastructure such as reservoirs and ponds from sediment, and reduce and repair land degradation, enhancing the productivity of both cropland and rangeland and resilience to climate change. Cash-for-work for construction and rehabilitation of ponds and some soil and water conservation activities will provide a significant injection of cash into the poorest households which will contribute to reduced indebtedness and improved household nutrition during times of food insecurity.

54. The Component contributes to the Myanmar Water Vision which states that "By the year 2030, the country will have an attainment of sustainability of water resources to ensure

sufficient water quantity of acceptable quality to meet the needs of people of country in terms of health, food security, economy and environment".

2. Component objective

55. The objective of the Component is to improve the health, food security and incomes of poor rural communities through increasing the availability of water for human and animal consumption, providing irrigation facilities where adequate water and suitable soils exist, and improving soil and water management on both cropland and rangeland.

56. The Soil and Water Component will focus on three major activities: 1. Domestic water supplies and sanitation – improved domestic water supplies are a priority in most villages; 2. Irrigation facilities for small groups of farmers; and 3. Soil and water conservation which is important to reduce and repair land degradation, to protect infrastructure such as ponds from sediment and to managing water effectively in rainfed systems at both field and watershed levels.

D. MAJOR ACTIVITIES AND PHASING

57. Initially the Component would support a baseline study in villages to determine (i) domestic water availability, its sources and scope for enhancing supplies; (ii) sites for irrigation where suitable soils and adequate water coincide; and (iii) the scope and scale of land degradation and possible interventions that would enhance infiltration and availability of water, and reduce erosion. A participatory, community based approach using tools such as community mapping would aid this study and guide planning of interventions. Close collaboration with Village Development Committees and the development and training of common interest groups for implementation of proposed activities are essential to long term sustainability. A number of INGOs in Myanmar have the skills needed for these activities but should work in close cooperation with relevant government departments, particularly DOA extension staff.

58. TA will be needed to oversee some activities such as site selection for new ponds and reservoirs, their survey and design, to investigate the quantity and quality of groundwater and its adequacy for irrigation where suitable soils have been identified, and for training of DOA extension staff in soil and water conservation techniques.

59. The table below shows the sub-components for Component 1 and the numbers of each of the main interventions proposed, phased over 4 years.

Table 1. Types of interventions, indicative numbers, and phasing for the Soil and Water Management Component

		Quantities				
	Unit	2014	2015	2016	2017	Total
A. Water supply and sanitation						
Tube Wells	no.		15	15	20	
Dug Wells	no.		15	15	15	45
Hand pumps	no.	10	30	30	30	100
New ponds	no.	-	-	15	15	30
Pond rehabilitation	no.	-	40	40	40	120
Roof Water Catchment	no.	-	300	300	300	900
Water filters	no.	100	1,000	1,000	1,500	3,600
Latrine Construction	no.	200	2,000	2,000	3,000	7,200
B. Irrigation						
Group - tubew ell irrigation	5 acres	-	5	10	10	25
Group - Irrigation from reservoirs/ponds	acre	-	30	60	60	150
C. Soil and Water Conservation						
Tree nurseries - materials, tools and supplies	nursery	2	10	8		20
Village Woodlots	ha		25	100	100	225
Materials for soil conservation w orks	ls		10	10	10	30
Tools & improved Implements	ls		10	10	10	30
D. Social Protection						
Cash for Work	prs/day	1,000	74,000	134,000	134,000	343,000

1. Sub-component 1 – Domestic water supplies and sanitation

60. **New ponds/reservoirs**. Sites for new ponds and reservoirs will be identified in Year 1 of the project as permits for construction can take a year or more to process. Construction will be undertaken in Years 3 and 4. Manual labour will be provided by the community under cash-for-work (see Annex 4: Social Protection, for details of organization and the basis for remuneration for cash-for-work). Heavy machinery may be needed, particularly for larger ponds and dams. Improving and protecting the catchment area should be an integral part of implementation to reduce siltation (see sub-component 3).

61. **Pond/reservoir rehabilitation**. In Year 1 ponds or reservoirs requiring rehabilitation and improvements will be identified, with implementation being undertaken in Years 2, 3 and 4. Works may include increasing the water storage volume, improving bunds and spillways, and reducing seepage through lining sandy storage areas with a layer clay if it is available nearby, or through the use of bentonite or flexible membranes if they can be shown to be cost effective. As with new ponds, measures to protect the catchment area are essential. Most communities have the skills to both construct and maintain these structures, but support may be needed in the form of technical advice, cash-for-work for community labour, or access to machinery. Consultation with the community as to design, construction and maintenance requirements and responsibilities is critical. Maintenance such as removal of silt and repair of bunds is required at least every 2-3 years, and in many cases annually. INGOs such as Solidarity International and Proximity have experience in pond rehabilitation and the formation and training of village water maintenance groups to operate and maintain water storage infrastructure. They have developed mechanisms to help ensure that the groups remain operational once they leave the village.

62. **Hand dug wells and hand pumps**. This is a relatively simple activity and implementation could start in Year 1, as soon as sites have been identified. The community should be responsible for well digging and assistance provided towards the cost of lining and providing a concrete parapet and apron. Where communities are interested, low cost locally produced hand pumps will be provided for both new and old wells to avoid the contamination resulting from open wells and the use of dirty containers to draw water.

63. **Tubewells**. Tubewells and storage tanks will be provided in areas where other water sources are severely limited for part of the year. In some cases existing tubewells could be rehabilitated. Suitable sites will be identified in Year 1 and implementation initiated in Year 2. Local contractors are available to undertake the work but the community should provide unskilled labour. Testing of all groundwater supplies, for both biological and chemical contaminants, is essential; traces of arsenic have been found in groundwater in some areas. This can be undertaken at the National Health Laboratory in Mandalay. The village should establish an operation and maintenance committee and households should pay sufficient for water to cover the cost of fuel and maintenance.

64. **Roof water harvesting and storage**. Starting in Year 2, the poorest households will be provided with guttering, downpipes and a storage tank. In the case of poor families with thatched roofs on their houses, the provision of corrugated iron sheets should be considered.

65. **Sanitation**: Starting in Year 1 poorer households will be provide with a squatting plate, pit and the wood for the shed frame and a door. They should provide the woven basket covers for the sides and thatch the roof.

66. **Hygiene education and water filters**. This activity will start in Year 1. Hygiene education will initially be targeted to pregnant women and those with young children. It will concentrate on issues such as the importance of hand washing, the benefits of clean water and the use of water filters, particularly for pond water (see Annex 5: Nutrition). Poorer families with young children will be provided with low cost, locally made ceramic water filters or assisted to renovate the UN-Habitat sand filters. Maintenance and cleaning of latrines, water filters and other water containers will be included in training.

2. Sub-component 2 – Irrigation

67. Sites with suitable soils for irrigation and adequate water will be identified in Year 1 and the formation and training of groups of interested farmers will be initiated. Scheme construction will take place in Years 2, 3 and 4. Both soil and water quality will be tested to ensure that irrigation is sustainable in the long term and, where quality is an issue, to determine mitigation measures required, such as leaching or gypsum application. Farmers will be encouraged to grow high value vegetables rather than rice; salt tolerant crops may be advisable in some cases. It is likely that sites suitable for irrigation are already occupied by individual farmers. If plot sizes are small this may not be an issue, but where land holdings are relatively large negotiation and compensation may be needed to persuade farmers to relinquish land to enable more families to benefit from irrigation.

68. Canals or piped water will be supplied to small areas of suitable soil below larger ponds and reservoirs. A gate and pipe through the bund, if not already in place, will be needed. In some cases it may be necessary to pump to higher adjacent land. An irrigated area of 10-20 acres

could be farmed by 20 to 30 households to provide vegetables for household consumption and for sale.

69. Where lifts from wells are low, water quality is adequate and suitable soils are available, pumped systems will be provided to small groups of farmers. A typical irrigation system would include an engine and pump, a pump house, a water storage tank and pipes and hosepipes, to irrigate about 5 acres, farmed by 5 to 10 households.

70. Irrigation systems will only be provided to groups of farmers and they should provide all the labour for construction. A maintenance committee will be formed for each system and trained. Farmers should pay all operation and maintenance costs. They will be encouraged to grow high value crops and provided with training in irrigation agronomy and assisted to access good quality seed and other inputs.

3. Sub-component 3 –Soil and water conservation

71. Land degradation and other environmental issues will be identified in Year 1. Most soil and water conservation activities will be implemented over Years 2, 3 and 4. Capacity building activities including training of DAO extension staff will be initiated in Year 2 (also, see Component 2). The project will not provide direct payments for conservation works directly benefiting individual households, but groups testing new techniques may be provided with incentives such as implements and materials. Cash-for-work will be provide for larger public works such as planting woodlots and catchment protection.

72. Participative, community based activities will be facilitated to:

- Raise awareness of natural resource issues including land degradation and it's causes;
- Form and train common interest groups to plan individual land and water management activities identified in as priorities by the community;
- Increase productivity and the incomes of farmers through:
    c. the promotion of conservation oriented farming of rainfed croplands;
    d. improved rangeland and pastures;
- Increase the supply of firewood and timber for construction from sustainable sources, thus reducing pressure on rangeland; and
- Reduce accelerated soil erosion and protect assets such as cropland and ponds.

73. **Physical techniques**. Techniques such as contour ploughing, contour earth or stone bunds, and "trash lines" formed from the residues of past crops, which farmers and extension staff are already familiar with, will be promoted on sloping cropland but no incentives will be provided. Cash-for-work may be needed for activities such as the creation of micro-catchments for woodlot tree planting, for gully control and to stabilised contour ridges with napier, vetiver or other perennial grasses in community areas.

74. **Agronomic and vegetative measures.** The main emphasis will be on promoting biological conservation and moisture retention techniques which make the best use of water where it falls, increase vegetative cover and generally improve soil structure and water holding capacity. These may include:

- Contour planting, strip cropping and relay cropping by individual farmers;
- Putting degraded sloping cropland under a permanent cover of fodder grasses and legumes, with incentives such as inputs and cash-for-work provided where appropriate;
- Conservation Agriculture techniques. This will require considerable training of both farmers and extension staff, as people in the project areas are not familiar with some of the techniques. On-farm tests and demonstrations will be a key component. Incentives in the form of implements such as jab planters and ox drawn rippers or direct planters will be provided to groups of interested farmers to assist planting through crop residues. (See Annex 2: Seed, Crops and Livestock Component for further details.)
- Planting of woodlots/leguminous shrubs and development of small tree nurseries to provide seedlings (perhaps one nursery serving 3 or 4 villages) where there is community interest and water is available nearby. Individuals or schools will be encouraged to set up tree nurseries and provided with materials, tools and inputs. The project will guarantee to buy a certain number of the seedlings for planting in the community woodlots. Cash-for-work will be provided for planting the woodlots and to ensure that seedlings are watered through the first dry season.

4. Groundwater studies

75. A necessary precursor to any large scale development of groundwater is an appraisal of groundwater resources including recharge, sustainable yield of aquifers and water quality. The 2013 IWMI study[1] recommended that past groundwater surveys should be completed and updated using modern remote sensing and GIS techniques, enabling detailed hydrogeological and hydrochemical maps of the CDZ to be produced. These would help to reduce the risk of over-extraction of groundwater and identify water quality issues, particularly the presence of arsenic and salinity. The Dry Zone includes large parts of the Magway, Mandalay and lower Sagaing Divisions, an area of over 50,000 km^2. Determining the groundwater resources underlying the CDZ would require the following:

- Identifying all the groundwater bearing formations in the study area;
- Determining the characteristics of the aquifers;
- Determining the quantity of groundwater water in the aquifers;
- Determining the quality of groundwater in the aquifers;
- Estimating the amount and rate of groundwater recharge, flow and storage;
- Assessing the potential for groundwater development .

76. The main activities would include desk studies of available information and data, acquisition and interpretation of satellite imagery, collection of data on existing wells, and a survey of local well-drilling companies and individuals to capture their knowledge and experience of groundwater resources. Other possible activities are resistivity and electromagnetic surveys and, if necessary, test drilling in some areas to fill in gaps in knowledge of the underlying geology and aquifers.

[1] IWMI (2013) Water Resource Assessment of the Dry Zone of Myanmar: Final Reports

77. Under the Dry Zone Development Programme the following activities are proposed:

a. A desk study to determine the information available[1], further information needed, how it should be obtained and costs.
b. Initiation of a survey of existing wells, starting with the collection and analysis of well data in the six proposed Townships as a training exercise, then expanding to the rest of the Programme districts.
c. A survey of well-drilling companies and individuals to capture informal local knowledge of the location, extent and reliability of groundwater resources
d. Establishment and testing of a central GIS system and database for groundwater wells, building on data held in local WRUD offices, which would gradually be extended throughout the CDZ and countrywide.
e. Training of government officials in GIS and database establishment, maintenance and use;
f. Training of government staff and survey teams in data requirements, use and maintenance of survey equipment, the compilation, analysis and evaluation of data and information collected, and the use of the wells database.
g. Workshops for potential users of the wells database – government staff, contractors, NGOs etc.

Costs (very rough at this stage) will include:
- International and local TA for the desk study and establishment of the GIS system and database - $50,000
- Computers, printers, software etc - $30,000
- Wages and allowances for survey teams - $50,000
- Motorbikes for survey teams - $25,000
- Equipment and materials for survey teams (GPS etc) - $10,000
- Training courses and workshops - $20,000

5. Links to other components and cross-cutting themes

78. This Component links to Component 2: Seeds, Crops and Livestock through provision of water for livestock, small irrigation systems for farmer groups, and most soil and water conservation activities.

79. Cash-for work for construction and rehabilitation of ponds and some soil and water conservation activities will be targeted to the poorest households and has strong links to the cross-cutting themes of social protection and nutrition. It will provide significant cash to households which will contribute to reduced indebtedness and improved household nutrition during times of food insecurity. Improved domestic water supplies and sanitation will lead to better health through reducing the incidence of waterborne diseases such as tropical enteropathy and diarrhoea which can cause chronic malnutrition. Participatory community activities and group formation and training will be an important element of most interventions.

[1] The most significant information sources are two unpublished works: (1) Drury, L.W. (1986) An assessment of the hydrogeology and geology in the Dry Zone, Central Burma. Australian Development Assistance Bureau and Ministry of Agriculture and Forests, Union of Burma. Draft Report. (2) Groundwater Development Consultants (1984) Burma Umbrella Project: Groundwater exploration and pilot development sub-project. Final Report. 3 Vols., Cambridge, UK.

F. SIGNIFICANT ASSUMPTIONS AND RISKS

80. Most interventions under this Component, such as rehabilitation of existing ponds and provision of wells, are not expected to have any significant adverse environmental impact. The construction of new ponds and dams however should be subject to an environmental assessment. People who lose land or are affected in some other way by the construction should be compensated. Any civil works contracts should include clauses requiring contractors to take minimize and mitigation any environmental damage, including attention to spoil pits, drainage, cleaning and storage of plant and equipment, and measures to deal with any contaminated run-off or waste.

81. There is a danger that providing incentives such as cash-for-work for pond construction and maintenance will lead to dependency. Communities may be unwilling to maintain facilities once payments stop. Incentives should be used with care and kept to a minimum. Village Development Committees and community groups must have sufficient training to understand the importance of maintenance and have the capacity to organize and carrying it out.

G. INDICATIVE COSTS AND BENEFITS

1. Indicative costs

82. At this stage indicative numbers of the different interventions proposed under Component 1, their phasing and costs are tentative. The total cost of the main interventions is USD 4.08 million over a 4 year period (The cost of TA is not included). A summary of costs by sub-component is provided in the Table 2 below and in detail in Appendix 1.

Table 2. Indicative costs of the Soil and Water Management Component

	Cost (USD)		
	Materials, equipment etc.	CfW	Total
A. Domentic water and sanitation	2,500,300	300,000	2,800,300
B. Irrigation	351,500	480,000	831,500
C. Soil and water conservation	355,000	77,500	432,500
CfW training		15,000	15,000
Total	**3,206,800**	**872,500**	**4,079,300**

83. Table 3. below shows how Cash-for-Work was estimated. The main activities requiring large numbers of workers for prolonged period are the construction of new ponds, the rehabilitation of old ponds and soil and water conservation works such as pond catchment protection and woodlot tree planting.

Table 3. Cash-for-Work calculation

	Cost (USD)					Number work days				
	Yr1	Yr2	Yr3	Yr 4	Total cost	Yr1	Yr2	Yr3	Yr 4	Total work days
New ponds	-	-	150,000	150,000				60,000	60,000	
Pond rehab	-	160,000	160,000	160,000			64,000	64,000	64,000	
S&W cons	2,500	25,000	25,000	25,000		1,000	10,000	10,000	10,000	
Total	**2,500**	**185,000**	**335,000**	**335,000**	**857,500**	**1,000**	**74,000**	**134,000**	**134,000**	**343,000**

For 1 village assume:

Average village has 150 hh and 5 people per household = 750 people in total
Half village population are adults = 375 people
20% of adults want CFW = 75 people per village
People are prepared to work 20 days/month for 3 months /yr = 75x20x3 working days = 4,500 working days/village/year available

2. Benefits

84. The project will target 240 villages in 6 townships and, whilst most of the activities implemented under this component will only be carried out in a portion of the villages, it is likely that all will benefit from some interventions. The benefits of better domestic water supplies and sanitation will include improved community hygiene and health and, particularly in the dry season, human resources will be released for more productive activities. The provision of irrigation will extend the growing season, increase farmer incomes and improve nutrition through making vegetables more readily available in villages. Soil and water conservation measures will help to reduce erosion and runoff in rainfed cropland and surrounding rangeland, protect infrastructure such as reservoirs and ponds from sediment, and reduce and repair land degradation, enhancing the productivity of both cropland and rangeland and resilience to climate change. Cash-for-work for construction and rehabilitation of ponds and some soil and water conservation activities will provide a significant injection of cash into the poorest households which will contribute to reduced indebtedness and improved household nutrition during times of food insecurity.

H. OUTSTANDING TASKS FOR DESIGN MISSION

85. The most important tasks for the design mission include detailing implementation methods, refining targets and improving cost estimates for proposed activities through discussions with government departments in Nay Pyi Taw, and with aid agencies and NGOs in Yangon that have designed and implemented similar interventions. Further information is needed on problem areas such as groundwater quality in the CDZ. Details on the local availability, reliability and cost of equipment and materials needs research (e.g. hand pumps for shallow wells, motorized pumps for irrigation, bentonite for sealing ponds).

86. **Water supply and sanitation.** The most important Government department are the Water Resource Utilization Department (WRUD) of MOAI, and the Department of Rural Development (DRD) in the Ministry of Livestock, Fisheries and Rural Development. In addition, it would useful to meet the Irrigation Division of MOAI which constructs some small dams for domestic water in the CDZ. Aid agencies such as UNICEF, UNDP, UN-Habitat and WHO and NGOs such as JICA Bridge Asia Japan ADRA, Proximity, Solidarity International and ActionAid have been active in the water supply sector in Myanmar.

87. **Irrigation**. The WRUD is responsible for pumped irrigation and the ID for surface systems. NGOs such as Proximity and Cesvi have experimented with small scale irrigation and drip systems. The possibility of initiating a database of groundwater wells and likely costs needs to be discussed with WRUD.

88. **Soil and water conservation**. Important government agencies include the Extension Division and Land Use Division under MOAI and the Dry Zone Greening Department of the Ministry of Forestry. UNEP and FAO are important sources of information and some NGOs have practical field experience with some techniques.

Appendix 1. Costs for Component 1: Soil and Water Management

		Quantities					Unit Cost	Base Cost (US$)				
	Unit	2014	2015	2016	2017	Total	(US$)	2014	2015	2016	2017	Total
I. Investment Costs												
A. Water Supply												
1. Tube Wells												
Engine and Pump	no.	-	15	15	20	50	2000	-	30,000	30,000	40,000	**100,000**
Water Tank	no.	-	15	15	20	50	500	-	7,500	7,500	10,000	**25,000**
Work	no.	-	15	15	20	50	1000	-	15,000	15,000	20,000	**50,000**
Subtotal								**0**	**52,500**	**52,500**	**70,000**	**175,000**
2. Dug Wells	no.	5	15	15	15	50	500	2,500	7,500	7,500	7,500	**25,000**
Hand pumps \a	no.	10	30	30	30	100	50	500	1,500	1,500	1,500	**5,000**
Subtotal								**3,000**	**9,000**	**9,000**	**9,000**	**30,000**
3. Ponds												-
Construction \b	no.	-	-	15	15	30	30000	-	-	450,000	450,000	**900,000**
Rehabilitation \c	no.	-	40	40	40	120	4000	-	160,000	160,000	160,000	**480,000**
Capacity Development - Well and Pond Maintenance	no.	10	20	30	40	100	500	5,000.00	10,000	15,000	20,000	**50,000**
Subtotal								**5,000.00**	**170,000**	**625,000**	**630,000**	**1,430,000**
4. Lab Testing of Pumped Water	no.	10	30	40	40	120	100	-	1,000	1,000	1,000	**3,000**
5. Roof Water Catchment \d	no.	-	300	300	300	900	250	-	75,000	75,000	75,000	**225,000**
Water filters \d	no.	100	1,000	1,000	1,500	3,600	8	800.00	8,000	8,000	12,000	**28,800**
Subtotal								**800**	**84,000**	**84,000**	**88,000**	**256,800**
6. Sanitation												
Capacity Development on Hygiene & Sanitation	no.	5	20	20	20	65	500	2,500	10,000	10,000	10,000	**32,500**
Latrine Construction \d	no.	200	2,000	2,000	3,000	7,200	80	16,000	160,000	160,000	240,000	**576,000**
Subtotal								18,500	170,000	170,000	250,000	**608,500**
A. Subtotal												**2,500,300**
B. Irrigation												
1. Group Pumped Irrigation \e	5 acres	-	5	10	10	25	7500	-	37,500	75,000	75,000	**187,500**
2. Group Irrigation from reservoirs/ponds	acre	-	30	60	60	150	1000	-	30,000	60,000	60,000	**150,000**
3. Capacity Building on Irrigation	Wks	10	20	20	20	70	200	2,000.0	4,000	4,000	4,000	**14,000**
B. Subtotal								**2,000**	**71,500**	**139,000**	**139,000**	**351,500**
C. Soil and Water Conservation												
Tree nurseries - materials, tools and supplies	nursery	2	10	8		20	2000	4,000.0	20,000	16,000	-	**40,000**
Village Woodlots \f	ha		25	100	100	225	1000	-	25,000	100,000	100,000	**225,000**
Materials for soil conservation works \g	ls		10	10	10	30	1000		10,000	10,000	10,000	**30,000**
Tools & improved Implements \h	ls		10	10	10	30	1500	-	15,000	15,000	15,000	**45,000**
Capacity building	trng	-	10	10	10	30	500	-	5,000	5,000	5,000	**15,000**
C. Subtotal								4,000	75,000	146,000	130,000	**355,000**
D. Social Protection												-
ToT training for Cash for Work	trng	6	-	-	-	6	2,500	15,000	-	-	-	**15,000**
Cash for Work \i	prs/day	1,000	74,000	134,000	134,000	343,000	2.5	2,500	185,000	335,000	335,000	**857,500**
D. Subtotal								17,500	185,000	335,000	335,000	**872,500**
Total Investment Costs								**50,800**	**817,000**	**1,560,500**	**1,651,000**	**4,079,300**

\a For existing and new wells

\b Assumes av cost of new pond is $40,000, $30,000 for machinery, materials etc. and $10,000 is CFW (under D)

\c Assumes av cost of rehabilitating pond is $8,000, $4,000 for machinery, materials etc. and $4,000 is CFW (under D)

\d poorest households

\e Well, engine, pumps, pump house, water storage tank, pipes & fittings, hosepipes and compensation for land owner.

\f Seedlings, tools and watering in first dry season - labour covered under CFW (under D)

\g 30 villages

\h 30 villages - incl. jab planters, ox drawn planters & rippers for conservation agiculture

\i Assumes up to 20% of adults in a village are prepared to work up to 20 days per month for up to 3 months/yr at USD 2.5 p.d. for new and rehabilitated ponds & soil cons works

Appendix 2. CDZ Sites Visited by the Soil and Water Specialist