PARTICIPATORY DESIGN OF COMMAND AREA REHABILITATION IN THE FERGANA VALLEY

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Abstract

The problems with the irrigation network O&M in the Fergana Valley of Uzbekistan occur widely. The system is deteriorating; this needs to be reversed if the full potential benefit of the interventions is to be realized. It is particularly important to implement measures which will: (i) allow more direct control of the water passing through the off-farm and on-farm irrigation canal network. This requires better real-time knowledge of need, recent and prevailing canal flows and the capacity to analyze and respond to this data. (ii) reduce physical losses (leakage and seepage) (iii) Reduce management losses by improving the matching of the distribution and timing of flows to the needs of farmers, thereby reducing: Volume of water used exclusively in filling canals rather than being delivered to the fields and flows being discharged to the drainage system, either directly or indirectly through fields. This requires much improved flow monitoring, up to date knowledge of WUA or farmers' water demands, appropriate decision support systems and active adjustments of water control structures based on the foregoing.

Within the scope of the project working with the WUAs and the communities to develop and implement the Command Area Rehabilitation works within the scope of Fergana Valley Water Resources Management Project, including liaising with the designers of the inter-farm works and local officials, surveys to enable agreement on components and to provide information to the Contractor to allow preparation of working drawings; checking these and dealing with adjustments during implementation are being achieved.

This result in achievement of maximum benefits by using limited funds through careful selection of the interventions, establish the feeling of ownership among the stakeholders and hence ensure sustainability.

Socio-economic Conditions in the Project Area

In 2006 the population of the Project Area was 488 600, of which 85% live in rural areas (State statistics) and the average household size is 5.9. Male / female distribution is about 49% / 51%. There are high levels of out-migration. Illiteracy is very low at 2% of the total population. The education level of women is only marginally below that of men.

73% of the population of the Project Area is economically active. Of these, 38% are employed in the agricultural sector (20% on dekhan farms), 30% in non-agricultural sectors and 5% are unemployed, but seeking employment.

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The average monthly cash income of families in the Project Area is about US$ 200; this is slightly below the national average, but close to the Fergana regional average. Some 60% of the surveyed households live on less than US$ 1 per day per person (not purchasing price parity adjusted). Analysis of state statistical data shows that in the Project Area budgets had to be subsidised from the central budget. Small business is not developing dynamically despite the increase in numbers. Profitability and productivity remain low since most small businesses focus primarily on the agricultural sector.

Almost all surveyed households (99%) own land; every third family has more than one plot. Nearly 99% of households have a tomorka (a garden plot, average area 0.12 ha), which is the most widespread form of land use. Private farms average about 20 ha but are currently far less productive. Dekhan farms, which include garden plots, occupy 15% of the land but are responsible for 66% by value of production (state statistical data).

Women make up 41% of all the employed and 45% of those working in the agricultural sector. More than 60% of working women are engaged in agricultural production and one third of these have additional employment outside agriculture. Women contribute 36% of the household cash income. One of main factors hindering equitable employment of women is the lack of vocational education.

Drainage problems have not caused serious public disputes and conflicts despite their severity.

There is a strong solidarity within communities and cooperation is the single most importing coping mechanism at this level. Makhalla members cooperate in solving irrigation and / or drainage problems. Some 92% of respondents consider cooperation to be vital and believe that they can only solve their problems by acting together. This is especially true in rural areas where 98% solve their problems through cooperation with their neighbours.

Communities are eager to utilize their capacity in an array of activities, ranging from participating in construction works, cleaning of the drainage network, providing food for construction workers, to collecting money for fuel. Initiators of these works are usually local autonomous bodies such as Assemblies of Rural Citizens (ARC) and Makhalla Committees. In urban settlements, townspeople participate in repairing and construction of drainage canals even more often than rural settlements.

Residents presume that the State has the principal responsibility in investing in the rehabilitation of the irrigation and drainage systems. They traditionally perceive irrigation and drainage as a public responsibility. Moreover, the current situation is attributed to the mismanagement of the State over the past decades, and so the State is considered to be liable for corrective action.

On the other hand, households do not shy away from responsibility for the operation and maintenance (O&M) of irrigation and drainage infrastructure. Indeed, 73% of land users believe that they should have the responsibility for maintenance of the drainage and irrigation systems on their own land plots.

Among private farmers, however, the willingness for ownership of O&M drops to 59%. This can be explained by the fact that private farms are long-term leaseholders and are forced to follow the dictate of the State with respect to crop selection, production and sales. They do not have the independence to choose any alternative agrarian activities on their land, and therefore believe that bearing the full responsibility for maintenance of irrigation and drainage system would be unfair under such strict State controls.

Water Users' Associations in the Project Area

As newly established institutions, WUAs face serious technical challenges. As the shirkats were reformed, WUAs acquired their existing machinery, which were already outdated and worn-out. The equipment is incapable of carrying out tasks required for proper maintenance of irrigation and drainage systems because it needs serious repair. WUAs are in financial deadlock. Their only source of income is farmer's fees. Despite the growing number of paying members, the membership fees do not even cover the cost of employing staff, let alone investments in repair of machinery and equipment. Even though the majority of the farmers are eager to pay their fees to the WUA, the financial restrictions they face serve as an impediment to fulfil payments. The State Order process acts as a barrier to collection of WUA fees since the WUAs have no right to enforce debt payments.

13% of private farmers and about 7% of dehkans consider WUAs as ineffective; they believe that the existing State institutions have the capacity to implement water distribution more efficiently than WUAs. However, despite their limited capacity, WUAs are recognized by the majority of the farmers as vital instruments for agrarian development. Some WUAs have gradually included dekhan farms into their service areas. As dekhan farms become formal water users, they pay the appropriate cost for irrigation water. Dekhan farmers are very interested in becoming WUA members. The sustainability of WUAs mainly depends on the financial stability of agricultural producers.

Irrigation & Drainage System in the Project Area

The irrigation and drainage systems in the Fergana Valley have multiple water sources, and multiple conveyance systems that are connected in several locations, including canal to drain and drain to canal.

The borders of the irrigation systems are organised to coincide with the raion borders rather than to reflect hydrological units. Local administrations have significant influence on the day to day allocation of irrigation water.

In the Project area there is a complex irrigation and drainage system. However, because of the way that the canals and drains are inter-connected, operation is difficult, with the consequent potential for relatively low water management efficiencies. Some parts of this system are still suffering from the change in circumstances around the time that Uzbekistan became independent.

A significant feature of the irrigation development is that in the Project area there are major canals which cut across the natural drainage paths. Other infrastructure designed to run parallel these canals also cuts across these paths.

There is evidence that some parts of the drainage system are being surcharged at present. This is attributable to some or all of: (i) Changes in distribution and use of water compared with original design concept; (ii) Changes in the upstream infrastructure, thereby increasing the flow carried; (iii) Loss of capacity due to lack of maintenance or modification of drain function; (iv) Increased drainage duty associated with excess water flowing in the canals or deficiencies in the canal water management; and (v) Increased drainage duty associated with changed groundwater flows and levels.

The consequence of this is that some areas have locally raised groundwater levels due to impeded drainage. The problem can be particularly apparent at structures, though open drain channels will also be affected.

Many of these physical problems originate in physical defects, or can be overcome by physical interventions. However, some of the problems are due to, or are exacerbated

by institutional and capacity aspects; some of the physical solutions available will only be effective in a modified institutional setting.

WUA command areas are mainly based on Shirkat boundaries, also not on water system boundaries.

The main and inter-farm water supply system is complex, and so is the water delivery to the WUAs. Each WUA might have several water sources from different canals, pumped as well as by gravity. Again it shows the complexity of the water systems and it stresses the need for a good management structure to ensure effective water management.

Effort is still required to establish WUAs as effective organisations which both understand their role and have the capacity to deliver on their obligations.

General: (i) Lack of perception among WUA members of how a WUA should function; (ii) WUA chairman is often also the WUA manager (and not independent of WUA line management). The chairman often is neither a farmer nor former Shirkat manager. The chairman is often on the WUA payroll; (iii) WUA Council members mainly consist of drivers, Mirabs, and other WUA staff; (iv) Rarely are there members independent of WUA line management on the WUA Council. Thus the concerns of other stakeholders – such as irrigators - are not represented independently at Council; (v) Not one WUA chairman or manager was able to draw the right organisational structure of their WUA; (vi) There is no clear definition of tasks between WUA organs; and (vii) There is a lack of planning and organisation evident.

WUA assets: (i) WUA facilities often are not adequate to the needs; (ii) Machinery and equipment are in use far beyond their design life. There is a consequent problem with frequent breakdowns, a lack of spare parts, and overall inefficient (thus costly) working; and (iii) General lack of facilities such as workshop, tools, warehouse, etc.

Financial: (i) WUAs are financially weak. The ISF collection rate is very low. This is because farmers do not have money to pay and payment of the ISF is a low priority among farmers; (ii) WUA and farmer bank accounts are operated by the state. Therefore the WUAs do not have effective control over these accounts; (iii) The main part of the WUA budget is expended on salaries. Shortfalls in the ISF collection results in salaries not being paid; and (iv) Poor knowledge of the tax system. There is a suggestion that over payment of taxes is commonplace, although it varies between raions.

Staff: (i) Excessive staffing levels in some cases, not suited to the efficient operation of a private business; (ii) High staff turnover. This is attributed to low motivation (including erratic payment of salaries); and (iii) Staff are poorly qualified.

It can be concluded that the WUAs will need a lot of support if they are to develop in the medium and long term.

The institutional environment in the study area, considering both where institutional structure and operation has an adverse impact, and where capacity constraints reduce the actual or potential effectiveness of water and soil management and implementation of I&D and agricultural development policy.

In recent years state policy decisions have resulted in radical changes to the institutional framework under which irrigation and drainage (I&D) and agriculture is practised. Although the policy framework to move these activities from control and management by the state to a private sector orientation is now largely in place, converting the policy into reality is a long and difficult process, with many problems to be solved.

As described below, both irrigation and drainage management and agriculture suffer from: (i) Weaknesses and constraints emanating from either policies which are inappropriate given the conditions of the study area, or from the way prevailing policies are implemented; and (ii) A lack of experience, training or knowledge among practitioners, at all levels, concerned with irrigation and drainage and agricultural activities.

The ultimate consequences of this are that: (i) crop yields are lower than they would otherwise be, given the prevailing physical conditions; (ii) the resources used in operation and management of the irrigation systems are not used efficiently; and (iii) water is not used effectively.

In other words the institutional constraints directly result in the costs of achieving sustainable agricultural output being higher than they need be. In addition, where the institutional and capacity-related weaknesses contribute to physical damage to infrastructure (such as roads and buildings), the weaknesses impose costs outside the agriculture and associated sectors.

The main issues which can be ascribed to institutional and capacity weaknesses in the operation, maintenance and management of the irrigation and drainage networks are:

Water distribution is not responsive to needs: (i) Local administration officials have considerable influence over water distribution. Decisions are often made on perceptions of water need, particularly favouring areas where crops are being grown under the state order system. However, there is no effective flow measurement nor is there effective monitoring. As a consequence there is no mechanism for making optimal use of the available water, nor to understand on what occasions this has happened and hence to replicate this on a regular basis; (ii) Because of the role of the local administrations in water distribution, farmers or WUAs may not receive water supplies when their crops need it if others with greater influence with the administrations seek preference. On the positive side, when water is short, the present arrangement at least guarantees some cropping success. However, the approach lacks the rigour that modern irrigation management demands; and (iii) In the absence of a rigorous process for determining water requirements on a day-to-day basis, water management staff have not honed their skills in modern water management delivery. Therefore, should a more rigorous system be introduced, training would be needed for it to work.

Limited control over discharges: (i) Fewer water control structures were provided with the original irrigation and drainage infrastructure than needed for good water management. Also, the structures that there are have deteriorated, some to the extent that they cannot be operated effectively. As a consequence there is little regard for using structures for hands-on water management, particularly to fine-tune water distribution. This ultimately leads to sub-optimal water distribution with over-supply in some locations (and so surcharging the drainage system) and under-supply elsewhere; and (ii) There is little consistent and reliable flow measurement occurring. Hence, it simply is not known how effective current water distribution is. The problem arises from a combination of the absence of good hydrometric installations, the lack of rigour in flow management and that arbitrary or preferential water allocation is widely practised but not formalised.

Over-watering: (i) For the reasons outlined above, over-watering is commonplace. Certain crops and certain areas receive water preferentially, sometimes in quantities beyond both their needs and the capacity of the existing drainage system to evacuate the excess; and (ii) The occurrence is compounded by the reliance on norms which are designed to encourage provision of more water than is strictly required. It can be argued that this is pragmatic, reflecting inefficiencies in the water distribution system (so even if there is a shortfall against the norm, the crop is adequately watered). Such

norms also allow for lapses over timing and setting stream sizes among irrigators. A consequence, however, is a tendency towards water logging.

Weak finances: (i) The system of main canals and drains is ultimately supported by government financing; WUAs depend on irrigation service fees. At both levels financing is insufficient to prevent progressive deterioration of the irrigation and drainage infrastructure or to support efficient water management; and (ii) Whilst the concerned organisations can be considered to be at the mercy of government or state decisions, they do not seem to have the required stature to be seen as the major stakeholders that they are in the success of the agricultural economy.

Maintenance is inadequate: (i) There is a clear deterioration in much of the irrigation and drainage infrastructure, ranging from structural deterioration, loss or inoperability of water control equipment like gates, siltation and clogging of drains and leakage and seepage from canals. Arguably strong institutions would not allow this to happen; that it does reflect the status of the relationship between the concerned organisations and the state; (ii) The situation is, of course, compounded by the weak finances discussed above; and (iii) However, there is a question of whether the institutions have a staff resource which is suitably skilled and attentive to address the maintenance deficit in a logical manner. This includes, for example, prioritising the most important activities. Should the organisations have better access to funds, it is believed from observations in the study area, that support would be needed to ensure such funds were used to best effect.

Measures Taken within the FWRMP

Considerable sums are required to return the network to an optimal condition. For FWRMP a sum of 15 000 mln UZS has been allocated to cover priority actions. This sum was determined from: (i) Consultation with the BAIS authorities; and (ii) For determining the on-farm canal system infrastructure rehabilitation requirements, three pilot WUAs were identified, one in each of the study raions.

Based on extrapolation of deficiency lists provided by the WUA authorities, necessary implementation works have been determined for the project area. These are mainly: (i) Cleaning and reshaping of canals; (ii) Repair of concrete linings; (iii) Repair of flumes; (iv) Repair and construction of turnout structures; (v) Repair and construction of water measuring structures and (vi) Repair of culverts.

In the absence of good corroborated data on the current performance of the canal system, it is difficult to reliably quantify the impact of these proposals. However, an order of magnitude impact can be deduced, as follows.

Realization of the proposed implementation measures will increase the system efficiency from the 0.52, as currently officially reported, to say, 0.70 and 0.75 in 2020 and 2030 respectively. This would result in a decrease of diverted water to the project area from 750 to 650 million m^3/yr, assuming the proposed future crop pattern is applied.

Participatory Irrigation & Drainage Design for FWRMP

The ***Consultant*** (JV Mott MacDonald - Temelsu) is responsible for working with the WUAs and the communities to develop and implement the CAR works, including liaising with the designers of the inter-farm works and local officials, surveys to enable agreement on components and to provide information to the Contractor to allow preparation of working drawings; checking these and dealing with adjustments during implementation.

Command Area Rehabilitation (CAR), both because the major constraint on effective water management is the poor state of the I&D infrastructure and because the more

time made available for the participatory processes the better the outcome – institutionally and physically.

CAR, within the context of this project, is the development or improvement of irrigation and drainage infrastructure, within the irrigated areas under the management of the WUAs, to improve the management, operation and effectiveness of irrigation. The detailed requirements will vary depending on several factors including the age of the irrigated area, the field sizes and the soil types.

A key objective of the CAR works is to provide a sound basis for the management and operation of the system. The works include some or all of the following: (i) rehabilitation of existing regulating structures on the inter farm canals; (ii) construction of new regulating structures on the inter farm canals; (iii) rehabilitation of existing on-farm canals and drains; (iv) construction of new on-farm canals and drains; (v) rehabilitation of existing on-farm canal and drain structures; and (vi) construction of new structures on the on-farm canals and drains.

All the on-farm canals and collectors within the pilot areas were surveyed with cross sections taken at intervals of around 100 m. All structures on the on-farm canals and collectors were also surveyed.

The following details were also recorded: (i) field boundaries; (ii) the alignment of roads and tracks; (iii) the location of significant buildings and plots of trees; (iv) the alignment of all utilities (pipelines, electricity lines, telephone lines); and (v) the location of pumps, wells and ponds.

Hydraulic analysis of the canal and collector network was carried out, and tools were developed for the processing of survey data. The process of developing suitable structures specifically for the pilot areas was curtailed due to a lack of available design staff and concern to begin the actual tender designs on schedule. Appropriate structures were therefore designed as part of the tender design process.

The survey and design work for the remaining WUAs will take place concurrently with the implementation of the works.

Each WUA has identified the works required within the areas under their management. The WUAs have been made aware that within the expenditure limit for their area it may not be possible for all the requested work to be carried out and, as noted above, have prioritized the list of required works to assist with the selection of works to be implemented.

Regular meetings are being held with the WUAs to ensure that they are aware of and understand: (i) what is meant by rehabilitation and that it does not involve restoring the system to its original design; (ii) that only selective improvements will be implemented and that complete reconstruction of the system will not take place; (iii) the importance of the prioritization process and of carrying it out in a logical manner; (iv) the need to identify clearly the location of any structures and key design requirements (e.g. design discharge); (v) the importance of including water control and measurement structures to provide a sound basis for operation and management of the system; and (vi) the need for proper coordination within the WUA so that no important items of work or areas of the system are overlooked.

There will be works proposed by the WUAs that are not able to be implemented within the budget. Should further funds become available at a project level, consideration of the significance of those works not implemented could be used to evaluate the effectiveness of allocating additional funds to the CAR works. This consideration could also help determine whether a needs-based distribution of additional funds (rather than a distribution on a ‘per-hectare’ basis) may be more appropriate, should any additional funds be allocated to CAR.

There is existing mapping of the irrigated areas at 1:10 000 scale. These maps will be used as a tool for identifying the location of the works proposed by the WUAs.

Work has been done with the WUAs to ensure that the names of each of the canals are correctly marked. The operating authorities hold existing designs for the inter farm canals and collectors. Experience to date has shown these to be unreliable for use in the design process. The canals and collectors in many cases do not appear to have been constructed as designed and the changes made during implementation have not been recorded on as-built drawings.

The WUA list of proposed works needs to be reviewed in consultation with the staff of the WUA. It is essential that the WUA is closely involved in the design process both to ensure their sense of ownership of the area under their management and to use the CAR design work to develop the WUA as an effective institution.

One of the project goals is to raise irrigation efficiencies, and thereby reduce the area affected by high water tables and the required drainage duty in the collector and disposal channels. However, as the CAR works are focused on removing bottlenecks affecting the WUAs, raising irrigation efficiency is a desirable but not essential component of CAR works.

A proforma has been developed for completion by WUAs, giving more detailed information on the works proposed. This proforma contains a number of questions which, although not intended to be a comprehensive list of all issues which may arise, will act as a prompt to ensure that no important factors are overlooked. Site visits with representatives from the WUA are important to clarify and confirm details.

Sufficient topographic survey is carried out to produce tender designs for the highest priority items on the WUA list. To help identify what will be surveyed, a preliminary estimate of the cost of the works has been developed, based on the costs established during the pilot area design process. Survey work will not take place over the whole of the area under the management of the WUA.

A simple condition survey is undertaken where structures have been identified as requiring rehabilitation to establish if would be more appropriate to repair the existing structure or for a replacement structure to be constructed.

Factors assessed during the condition survey should include: (i) the overall functionality of the structure; (ii) the condition of the main structure; (iii) the condition of any erosion protection; (iv) the condition of any water control equipment; and (v) the condition of any access and / or safety facilities.

A plan is produced at an appropriate scale for each of the WUAs showing the area under their management. The position of all the proposed works included in the initial 11 000 ha design is marked on this plan together with a legend which will detail the type of work at each location.

A preliminary indicative list of works proposed by other WUAs has been produced, giving only a possible range of each type of work to be included (i.e. the number of structures of a particular size; the quantity of collector cleaning earthworks and the number of collectors proposed). This list has been clearly labeled as being subject to change.

Standard spreadsheets have been developed to assist in the design of canal and collector re-profiling works. The output from the spreadsheets will be a profile of the remodeled channel together with the details of the typical design sections. For on-farm canals, the location of structures will be shown.

The designs are standardized as far as possible. The type of structure and its location will be marked on the plan drawing for the relevant WUA. More detailed information such as design invert levels and the capacity of each structure will be contained in an accompanying table of design information which will be included in the tender documents. Separate drawings will not be produced for each structure; the contractor will prepare the necessary working drawings prior to construction.

The WUAs have a key role to play in the CAR design process as shown in Figure 1. The final list of designs is discussed with the WUA and should be approved in a general meeting.

The CAR works are being implemented to address immediate and pressing concerns affecting the WUAs. However, as noted above, a basic assessment will be made of the effectiveness of the proposed work. In doing this, information may be sought from organizations with knowledge of conditions in other parts of the irrigation and drainage system. However, there is no requirement for obtaining approval of bodies other than the WUAs except where the proposed works are located in parts of the irrigation and drainage system which is not under WUA control.

Working commissions have been established by the PIU. These commissions contain representatives from all of the relevant local authorities, and thus will be consulted when the list of works are finalized. It is anticipated that their approval will take the form of a map showing all of the works, signed as approved by all relevant parties.

The aims of CAR are to remove bottlenecks from the system, and improve water management. The funds for CAR are a one-off investment, and thus should be invested wisely. The following guidelines have helped in the prioritization process: (i) The cost of the works must be appropriate to the area served; (ii) The works should represent a capital investment, rather than ongoing maintenance; (iii) Priority is given to those works which are necessary for farmers to receive benefit from the lower water levels in the collector-drainage network as a result of the Project interventions; and (v) Priority is given to those works which will facilitate improved water management.

As discussed above, tender designs have been prepared for three WUAs. The quantities for the tender have been estimated using the quantities from these three WUAs; the quantities were increased in proportion to the amount of irrigated land with a similar irrigation situation.

A further check was carried out based on the suggestions of all the WUAs; using the typical structures developed, and average quantities based on the tender designs completed, a rough estimate was made of which items from the WUA suggestions could be included (from both a technical and an economic viewpoint). This was found to be in reasonable agreement with the calculated quantities.

Conclusion

The problems with the irrigation network O&M in the Fergana Valley of Uzbekistan occur widely. The system is deteriorating; this needs to be reversed if the full potential benefit of the interventions is to be realized. This requires much improved flow monitoring, up to date knowledge of WUA or farmers' water demands, appropriate decision support systems and active adjustments of water control structures based on the foregoing. Within the scope of the project working with the WUAs and the communities to develop and implement the CAR works within the scope of FWRM, including liaising with the designers of the inter-farm works and local officials, surveys to enable agreement on components and to provide information to the Contractor to allow preparation of working drawings; checking these and dealing with adjustments during implementation are being achieved. This result in achievement of maximum

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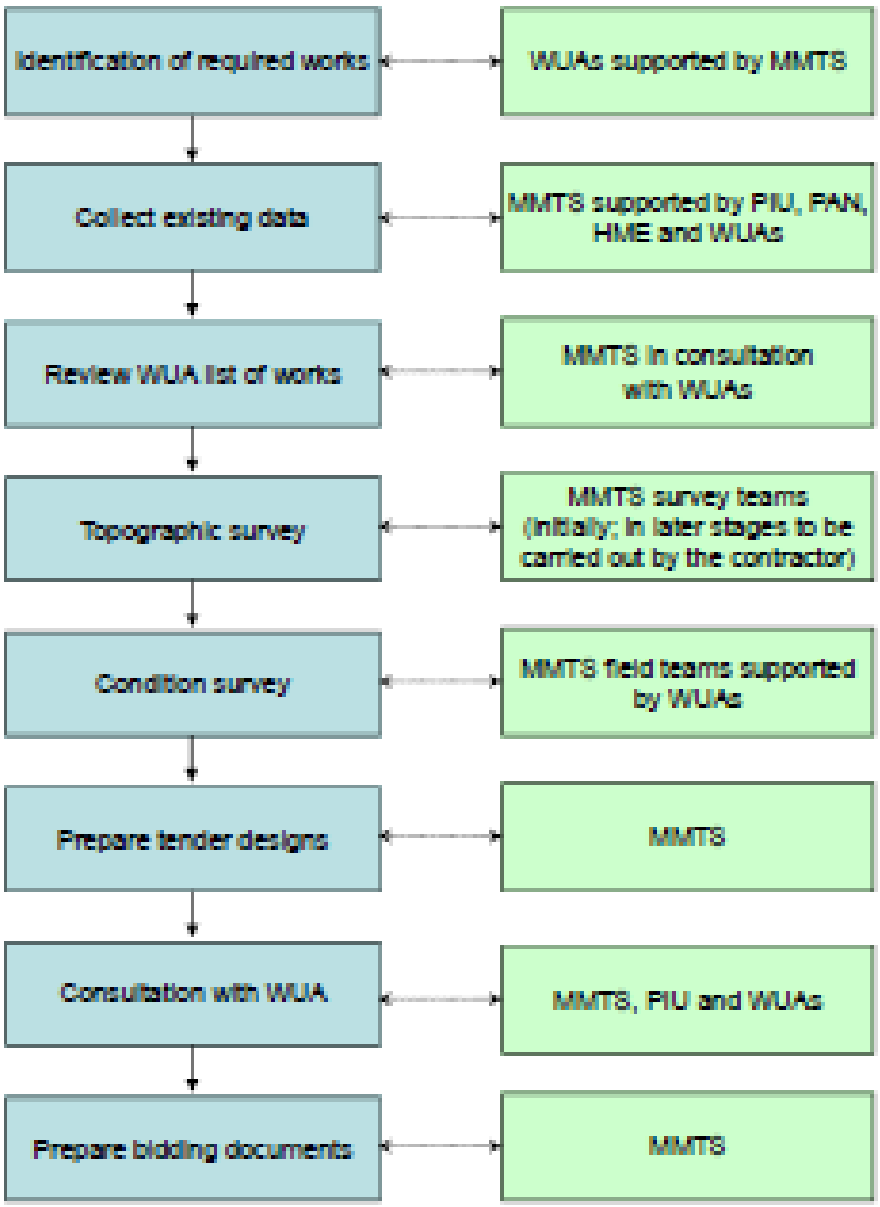

Figure 1 Participatory Design Process