A journey through Watersheds

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# EMERGING CONCEPTS ON MANAGEMENT AND TECHNOLOGY IN THE WATERSHED PROGRAMME UNDER THE CHANGING PARADIGMS

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## INTRODUCTION

*Subject matter specialists propose a range of technological options but final decisions are made by concerned users*

At present, more than Rs. 9000 million are invested annually on watershed projects in India through different organizations, a major investor being the Government of India. The impact of the watershed programme during the project period has indeed been impressive in many areas. However, so far, post-project sustainability has not received the needed attention, and continues to be a challenge despite the adoption of new guidelines in 1994.

From the mid-nineties, there has been a major paradigm shift (from a top down approach to a participatory approach). It was thought that this approach would address the issues related to post-project sustainability. However a clear withdrawal strategy was not included in the scheme of things. In the revised guidelines (2001), besides inclusion of a withdrawal strategy, additional efforts are also being made to address equity- and gender-related aspects. Facilitation of active participation of resource-poor families (RPF) would lead from this.

With the changing paradigms, new roles to be played by different stakeholders have come to the fore, concurrent with relevant changes in the mechanisms and operational modalities. Under the new approach, social and management aspects are becoming equally important unlike the earlier attention given primarily to technological aspects. On account of the changing scenario a number of new concepts are emerging that need to be properly integrated.

## 2. EMERGING CONCEPTS

### 2.1 Higher level of investment on indigenous technologies for development of natural resources

Farmers have, for ages, developed private natural resource themselves at their own cost. During the course of some studies, a large number of traditional/indigenous technologies have been identified that are relevant for specific areas and situations. Under the ongoing participatory approach, farmers are encouraged to propose their preferred technological options (which may include exogenous and/or indigenous options) based upon their knowledge of their own needs and situations.

Recent case studies of 25 watersheds in Andhra Pradesh have shown that adoption of indigenous technologies for development of natural resources has been varying from component to component and also from watershed to watershed (Table 1) depending upon the funding agency as well as the implementing agency (MANAGE, 2003).

Table 1. Adoption of indigenous and exogenous technological options for development of natural resources under the watershed programme

| S.No. | Type of natural resource | Average adoption of technological options(%) | |
|---|---|---|---|
| | | Indigenous | Exogenous |
| 1 | Private land resource | 80 | 20 |
| 2 | Water resource | 43 | 57 |
| 3 | Drainage course | 26 | 74 |
| 4 | Common land resource | 24 | 76 |

In most of the above watersheds, *in situ* conservation of soil and moisture has been done essentially through indigenous technologies. This has resulted in a striking change from contour-based measures to boundary-based measures. Type of material (vegetative, earthen or stone) and size of measures (small or large size bund) have, however, varied from place to place depending upon the need and the availability of material. Development of water resources has been done through a mixture

*Stone bunding is a preferred option of the farmers*

of indigenous and exogenous technologies — the proportion these, however, varied from watershed to watershed. Development of drainage course and of common land has by and large been done though exogenous technologies including gully control structures (for reduction of bed erosion in drainage course) and new plantation of economically valuable trees (in common land).

Analysis has shown that sustainability of intervention for development of drainage course can be substantially increased if higher investments are made in indigenous technologies (including soil-harvesting structures for levelling the bed area and then using it for cultivation of arable crops). Likewise, sustainability of biomass in common land can be increased if initial emphasis is given to indigenous management systems, (eg. natural regeneration of existing biomass through social fencing) before investing on new plantation of trees of high economical value (MANAGE, 2003).

## 2.2 Implementing a wide range of technological options rather than a limited number of standardised solutions

Under irrigated conditions, there is a considerable similarity in situation over wide stretches of area. So, a large number of farmers tend to adopt similar types of technological options. Under rainfed conditions, however, diversity and complexity are very high even over a small area, due to greater variation in physical, social, infrastructural and economic features. Under such conditions, a limited number of standardised solutions may not be able to meet the needs of all types of farmers and niches observed in a particular area. Thus, a wide range of technological options may be required for development of each type of natural resource in these areas.

Development of water resource in Manchal watershed (in Rangareddy district of Andhra Pradesh) is a good example of the above point (MANAGE, 2000). In this watershed, covering an area of 4,500 ha, over 10 types of water harvesting structures have been identified, which include eight types of options based on indigenous technologies / options and two types of options based on exogenous knowledge / options (Table 2).

Table 2: Type of water harvesting structures in Manchal watershed (red soil)

| Sl. No. | Type of structure | No. of units of each structure | Average cost per structure (Rs in 000's) |
|---|---|---|---|
| A | **Indigenous structures** | | |
| 1 | Strengthening of existing percolation tank | 6 | 68 |
| 2 | Conversion of irrigation tank into percolation tank | 21 | 63 |
| 3 | Repair of breached tank | 4 | 71 |
| 4 | New percolation tank | 22 | 58 |
| 5 | Feeder channel | 3 | 40 |
| 6 | *Jal kunta* (seepage pond) | 8 | 3 |
| 7 | *Katwa* (diversion structure) | 8 | 20 |
| 8 | *Yatam kunta* (dug out pond) | 36 | 2 |
| B | **Exogenous structures** | | |
| 9 | Drop wall | 7 | 20 |
| 10 | Check dam | 7 | 112 |
| | TOTAL | 122 | - |

Each of these types of structures was found suitable for a specific niche within the overall diversity in the watershed area. It would therefore be appropriate to inform farmers about a range of technological options and advise them to choose the one best suited to their

*Jal Kunta irrigated fields (Indigenous)*

*Checkdam on a drainage line*

own complex situation (about which they know more) rather than to implement a limited number of standardised exogenous solutions over the entire area.

### 2.3 Adoption of soil conservation measures only in the fields affected by erosion problem:

The watershed area may suffer from any of the following types of soil erosion — sheet, rill or gully. Sheet erosion is expected to be managed through cultural practices. Rill erosion requires mechanical or vegetative barriers, which could be created out of soil, stone or vegetation. Gully erosion, however, requires specific checks — stone or vegetative or a combination of both.

It has been commonly observed that the magnitude of rill erosion in private land varies from field to field depending not only upon variation in slope and texture

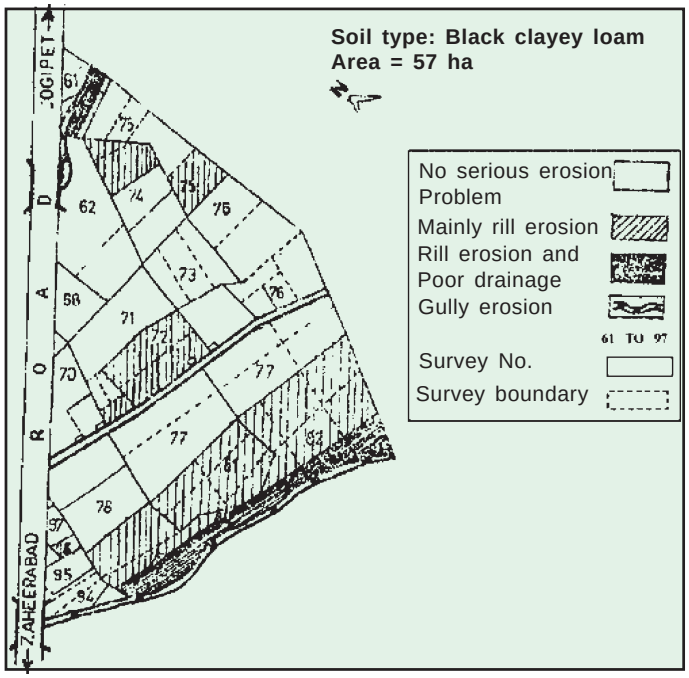


*Fig 1. Extent of soil erosion in Chevella watershed (Medak district)*

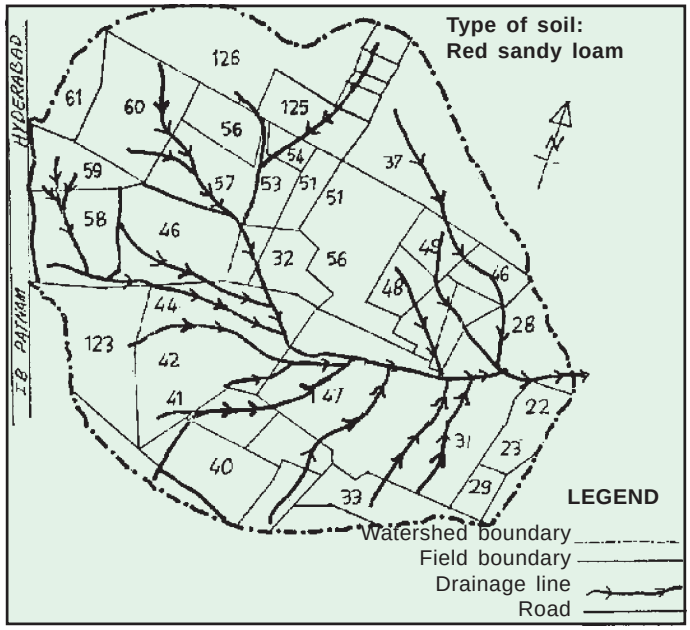


Fig 2. Extent of rill erosion in Patelgudem watershed (Ranga Reddy district)

of the soil, but also on the extent of indigenous measures already adopted by farmers at their own cost. The rill maps of two separate watersheds (one in black soil of Chevella village and the other in red soil of Patelgudam village) indicate the range of variability in erosion problems among different watersheds (Figs.1 and 2).

In the first watershed, only 22 percent of the sample area was affected by rill erosion, whereas in the second watershed the entire area was affected. In Chevella watershed, investment on mechanical bunds should obviously be made only in those fields which are affected by rill erosion rather than treating the entire area under the watershed.

### 2.4 Flexibility in ridge to valley approach to facilitate participation of community members at their own pace

The ridge to valley approach is scientifically sound for the development of natural resources under the watershed programme. It minimises siltation of water harvesting structures in lower areas, and reduces the overall cost of proposed measures. It is however observed that all farmers from ridge to valley do not get motivated to participate in the soil conservation programme at the same time, particularly if they are expected to pay the required contribution in advance. It is possible that the concerned land has already been developed by farmers themselves, land treatment may not be required due to presence of mild slope, or it may not be worth

developing at this stage due to the farmer being occupied with other important sources of income. Under such situations, it may be appropriate to pursue an individual-oriented approach (with only willing farmers). This approach may lead to somewhat scattered development, particularly in the initial stage of the project. To overcome the problems associated with scattered development, it may be essential to make necessary modifications in the design of technological measures (in case farmers in upper areas do not come forward to participate). This may involve steps like increasing the size of waste weir for proper surplussing arrangements or construction of a vented check dam in place of solid check dam for harvesting the rainwater.

Conservation of soil on scattered basis (instead of total area basis) would be successful if indigenous methods of soil conservation (boundary based measures) are adopted in place of contour-based measures. Under this approach, the rest of the farmers can, of course, participate at their own pace during subsequent years.

### 2.5 More attention towards regeneration of post-rainy season flow in drainage course

Post-rainy season flow in drainage course would be very helpful in increasing the availability of water over a longer period within a particular year. Percolation measures adopted in the upper area of the catchment usually contribute significantly to improvement of base flow in lower areas during the post-rainy season. A few decades ago, forest cover in upper area used to be heavy, which helped enhance the percolation of rainwater. Due to biotic pressure, vegetation has now become sparse.

Thus mechanical measures (continuous contour trenching, staggered contour trenching etc.) have been put in place, particularly in the following two types of situations: (i) where common /private land in the upper reaches is covered mainly with degraded grass component (without many forest trees), or (ii) where upper land cannot be covered with forest due to difficulty in operationalisation of a social fencing system.

At present low emphasis is given to enhancement of post-rainy season flow in most watersheds. It would be appropriate if attention is focused on this aspect. For this purpose, any of the options discussed earlier may be used depending upon availability of funds and feasibility of social action.

### 2.6 Bargaining for equity in favour of resource-poor families

The watershed project deals with development of both private property resources (PPRs) and common property resources (CPRs). The CPRs may include common land (owned by revenue department/forest department etc,) and common water (which may include surface as well as ground water).

The community should be properly orientated with respect to equity aspects and a proper resolution should be taken before final selection of a habitat for the project. If this is done, it is possible to bargain for equity in favour of resource poor families (RPFs) with regard to sharing of community-oriented resources to be developed under the project. The following aspects should specifically be considered in this connection:

- Preferential allocation of usufruct over the developed biomass in common land to mature self-help groups
- Allocation of a part of the newly-developed groundwater resource to RPFs by encouraging them to dig community- bore wells near water harvesting structures constructed under the project, with an undertaking that they shall use it for irrigation of low water requiring crops, and use for domestic purposes only in case of drought
- There should be a priority set for drinking water facility

Bargaining for equity (in favour of RPFs) may also be facilitated for utilisation of private property resource particularly in cases where such resources are under-utilized by resource rich families (RRFs) eg. fallow land and bed area of drainage course, wherever such situations are seen. Such resources (owned by RRFs) may be developed into productive assets through investment under the project provided these could be given to SHGs of RPFs on lease basis. Such an arrangement of leasing the resource to a group of RPFs (rather than to individuals) may minimise the risk of RRFs losing ownership of land and justify investment of public fund for development of such resources.

### 2.7 Understanding the reasons behind land use conflict before suggesting alternate land use systems

Under normal circumstances, land is expected to be used according to its capability class. Broadly speaking, lands having capability class I to IV are to

be used for cultivation of annual crops, whereas lands having capability class V to VIII are to be left for plantation of perennial vegetation (pasture, trees including fruit plantation, etc.)

With the present population pressure in rural areas, two types of land use conflicts are observed. The good land (of capability class III and IV) is being left fallow, which usually happens with large holders who cannot manage their entire area under crops. On the other hand, the poor quality land (of capability class V and above) is being put to annual crops, which usually happens with small-holders who do not have better quality land to raise food crops for meeting the needs of the family. Even class I and II lands are diverted to tree farming for two reasons. First, the large holders who own such lands can avoid labour problems by shifting to tree farming. Second, they could reside outside the country and tree farming thus suits them. Reasons under such situations appear genuine, so changing the land use system in such cases may not be feasible although existing land use is not proper.

There has however been some attempt to improve upon the above situation. The RRFs (who are keeping good quality land as fallow) have been approached by RPFs for taking their land on lease through SHG for cultivation of annual crops as cited earlier. In such cases, the investment on fallow lands could be made out of project funds. Likewise, further degradation of poor quality land (being put under annual crops) is being minimised by constructing boundary based earth or stone bunds so that eroded soil from upper area can be concentrated on the lower side of the field. Over the years this improves the slope of the field as well as overall productivity. Whenever possible such lands could be put under tree farming (eg. agroforestry or agrihorticulture) system so that, later on, tree cover will take over the entire area. Until then the farmer can get a reasonable annual income through the agricultural crops.

## 3. ISSUES AND QUESTIONS

### 3.1 Is it worthwhile to convert surface water resource into ground water resource by closing the sluice valve of irrigation tanks?

In the southern states, irrigation tanks are commonly observed, particularly in red soil areas. Many of these tanks were constructed about 8-10 centuries ago. Even now, most villages have at least 1-2 such tanks. Before independence the main purpose of these tanks was to store the surplus runoff for supporting irrigated crops and livestock (during rainy season as well as post-rainy season). During the 1960s, as population pressure increased, and with the increased availability of cheap electricity in rural areas, farmers started exploiting groundwater resources through open wells for bringing additional area under irrigation.

During the 1980s and '90s, supply of irrigation water from open wells became inadequate to meet the further growing requirement. At that stage, the farmers started digging bore wells. In fact, bore well digging was cheaper than digging open wells. However, due to over-exploitation of the ground water, the water table had been consistently going down even in bore wells. Two types of technological options emerged for addressing the above problem. An exogenous option being currently adopted on a large scale under the government-funded watershed programme) involves construction of community-oriented water harvesting structures like check dams for recharging of groundwater resource. Simultaneously an indigenous option also emerged (which is currently being adopted by a few innovative communities at their own cost), which involves conversion of existing irrigation tanks into percolation tanks. The above indigenous option has been found effective, particularly in two types of situations: (i) where most of the command area under the tank is irrigated not only by the tank water but also by well / bore well water, thanks to the availability of cheap electricity; and (ii) where tank bed area continues to be a common property resource without any private encroachment.

By and large the indigenous option is cheaper and it has helped increase the net irrigated area (due to increased efficiency in water use) besides significantly increasing fish production (due to long periods of standing water in the tank bed area). The above option is gradually being adopted in more villages, particularly in situations where proper facilitation is carried out to resolve conflicts between farmers with no wells and farmers owning wells in the tank command area; and between private landowners in the bed area and well /borewell owners in the command area of the tank. However, the treatment of the catchment for sustainability and the access of water to tail end users require active consideration. Further, hydrological studies on the present extraction levels are needed. All such conversions (of irrigation tanks into percolation tanks) need to be taken up in a participatory way and

on a cascade basis to address the problems of hydrological aspects and to reduce the costs.

There is, however, a need to assess the implications of the above indigenous option, which results in a major change in the status of water resource (from surface water to groundwater), with particular regard to the following aspects:

- Whether overall access of water to RPFs will be reduced (since majority of RPFs do not own the land in the existing tank command areas)
- Whether cost of lifting of water will increase beyond the capacity of the farmers in the tank command area, particularly if subsidy on electricity charges are withdrawn
- Whether there will be increased conflict among community members on account of the above technological option, particularly in areas where there are more well-less farmers in the tank command area, and where tank bed area is already owned /encroached on by private individuals
- Whether it will become difficult to increase area under crops with low water requirement, since the command area under most tanks is put to paddy crop
- Whether recharge of wells/borewells located in upper catchment areas will become low (if most of the runoff water continues to be brought to conventional tanks in the lower area)

### 3.2 Should common land/degraded forest land be used for promoting tree-based livelihoods or for supporting animal-based production system?

At present development of common land is carried out essentially through plantation of forest trees. Hence, the forest department assumes the lead responsibility for development of such areas. This approach is undoubtedly based upon the sound principle of ecological development. Besides this, it helps promote tree-based livelihoods for RPFs. Such an approach also helps reduce flash floods during the rainy season and consequently increases recharge of groundwater as well as base flow during the post-rainy season.

It is however being recognized that people, particularly in low rainfall areas, are relatively more keen to use the common land resource for supporting animal-based production systems. This involves using the land primarily for higher production of grasses and fodder trees/ shrubs. Under this approach, population of forest trees has to be as low as possible and preferably of those species that provide fodder for animals (rather than high value commercial produce).

### 3.3 Should base flow in watershed area be developed through biological measures or through mechanical measures, particularly in common land?

As discussed above, tree cover in common land provides a direct benefit (by providing raw material for a number of tree-based livelihoods) and an indirect benefit (by enhancing the percolation of rainwater, thereby increasing the recharge in open wells/borewells, as well as post-rainy base flow in drainage course).

However, there is a gradual decline in the forest cover in common land/forest land. Consequently, there is an increase in production of grass from the same area, which incidentally helps livestock farmers. There is however a considerable loss (due to the above change) to the irrigated farmers who depend upon the ground water resource/base flow. Hence, there is a need to assess whether in such situations the base flow during the post-rainy season could be increased through mechanical measures (continued contour trenching and/or staggered contour trenching) rather than through biological measures (forestry).

The biological option may cost less, but its sustainability depends upon social fencing (social regulation against overexploitation). On the other hand, although mechanical measures may not require any special social action/ group action, initial costs (of digging the trenches) could be high. Of course, post-operational maintenance also needs attention. It would therefore be appropriate to work out situations where a particular option would be relevant rather than judging the comparative efficiency of one option over the other. If both options are feasible, a better solution might emerge.

### 3.4 Is it possible to adopt the following two guiding principles without significantly compromising on technical standards?

**(a) We should participate in their plans rather than the other way round:**

Under the demand driven participatory approach, it is expected that major part of the investment would be made on those technological options that farmers prefer. This approach seems sound, as it encourages

their active participation, which may eventually lead to greater degree of post-project sustainability. But in most cases, farmers prefer indigenous options for development of natural resources. Often, these options are not approved by the funding agency because of the following reasons: (i) some appear too ordinary to be included under the project (eg. removal of boulders and bushes in private fallow land); (ii) some are too costly (desilting of tank bed, leveling of private land etc.); (iii) their formal Standard Scheduled Rates (SSR) have not yet been worked out, and (iv) field inspection of such options becomes difficult during the implementation stage.

**(b) Livelihood-based development of natural resources rather than area-based development:**

Conventionally, the area-based approach has been followed for development of natural resources. Under this approach, the required area is demarcated on the topo-sheet / cadastral map. Subsequently, planning and implementation is restricted in those fields that are located within the demarcated area. This approach makes it easier to adopt the ridge to valley concept during planning and implementing of the programme.

The alternate approach of livelihood based development of natural resource does not begin with a demarcated area but with a group of farmers associated with a particular livelihood (eg.milch animal owners; agricultural crop producers; vegetable growers, neem kernel sellers, tamarind processors). Development of natural resources (owned/managed by concerned users) is however essential to improve sustainability of the above livelihood, through proper planning and implementation. Under this approach, the development of natural resources can be done in a scattered manner depending upon the motivation/ need of the farmer.

*Vegetable and flower cultivation as a livelihood support system*

### 3.5 Is it an appropriate time to carry out further decentralization in management of the watershed programme?

Before the mid-nineties, much of the watershed programme under the public sector was planned and implemented by a watershed development team (WDT) resulting in a WDT centred programme. Under this setup, community participation was low and passive. Later, special provisions were created in the guidelines to facilitate active participation of the community. These provisions include: direct funding to the community, organisation of the community into a new institutional setup, demand-driven participatory planning, contribution from users, and implementation of work by people themselves.

Such provisions have considerably increased community participation in the watershed programme. The new provisions have however resulted in a greater empowerment of *watershed committees* (WC) rather than the *watershed community*. Hence, it is now resulting in a WC-centred programme.

It is therefore essential to consider whether the programme could be further decentralized (from a WC-centred to SHG-centred programme. Under the new proposal, the WC shall continue to receive the funds (from the funding agency) but it shall not directly spend it for implementation of works. Preparation of action plan and implementation of works shall be carried out by SHGs and UGs. Hence, the WC shall transfer the funds to the above groups against the approved action plan, and these groups, in turn, shall use them for implementation of the approved works. Thus the preparation of action plan and implementation of works shall be carried out by self-help groups and user groups.

### 3.6 Can natural resource development be achieved through a revolving fund approach rather than subsidy-oriented approach?

A number of technological interventions for natural resource development are highly cost effective (pay-back period being 3-4 years). These include indigenous and exogenous technological options,

depending upon the need and the situation. It is also well known that traditionally, farmers have been developing their land and water resources through their own investment. The number of such farmers has, however, been limited due to various reasons (including lack of access to long-term credit, difficulty in proper demarcation of ownership boundaries, and inability to facilitate group action/ conflict resolution for community-oriented works).

However, the above constraints could be addressed satisfactorily by adopting revolving fund (RF) approach (in place of the subsidy-oriented mode), where the RF must be routed through mature self help groups. This approach has worked satisfactorily not only for promotion of income generation activities but also for development of natural resources (MYRADA, 1992). Under this approach, group members have the freedom to choose any type of technological intervention (indigenous or exogenous) for the development of their privately-owned natural resources, provided they are willing to do it by taking a soft loan from the common fund (created under the project) with the mature SHG. They are expected to return the loan to their own group after the development of the natural resource. The amount is returned in small monthly instalments over a long period (3-4 years). The concerned members become eligible to take a fresh loan (for development of leftover natural resources) after settling the earlier loan. Under this approach, each SHG may be given about 25 percent of the total requirement of its group members.

After completion of developmental work in private land, the original common fund could be considered as an incentive by the group for development of their community-oriented natural resources.

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## 4. CONCLUSION

In summary, we need to realize that in any area development programme, a wide range of options is needed. They should also include the indigenous knowledge systems. In a watershed programme, there can be flexibility in the ridge to valley approach with priority to treat the affected area, of course with the approval of the concerned stake holders.

In order to sustain the recharge of ground water, it should be frugally used through approaches like Participatory Hydrological Monitoring (PWM). Attention is required to augment post rainy season base flow, as well. Converting tanks into percolation tanks warrants a deep consideration on social as well as economic issues, besides long term sustainability.

Livelihood based support system should be top on the agenda with a proper blend of regeneration activities of the natural resources. In the present people-centred approach, we need to further decentralize and assist in implementing the demand driven participatory action plans evolved by the people. Converting the development funds meant for improving private lands into a revolving fund would further enhance the sustainability of the programme beyond the project implementation period.

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