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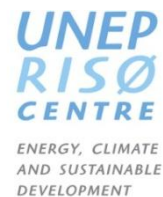
TECHNOLOGY NEEDS ASSESSMENT

**Report on Barrier Analysis and Enabling Framework
For Diffusion of Prioritized Adaptation Technologies in the
Water and Agriculture Sectors**

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GHANA TECHNOLOGY NEEDS ASSESSMENT

Report on Barrier Analysis and Enabling Framework For Prioritized Adaptation Technologies in the Water and Agricultural Sectors

TNA Project Team

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Dr. George Owusu Essegbey

Lead Expert

February 2013

FOREWORD

Adaptation is very essential in addressing the negative impacts of climate change. In order for national economic sectors to be robust to the impact of climate change, most developing countries have prioritized various adaptation measures to address climate change impacts particularly through the development and diffusion of environmentally sound technologies.

However, the transfer and diffusion of technologies for climate change adaptation, are hindered by all kinds of barriers. Thus, in order to effectively deploy relevant technologies, there is the need for execution of three main activities. These are the identification of barriers, the formulation of measures to address them and the development of strategies to create the enabling environment for adaptation.

The exercise of barrier identification and the related activities were done in the TNA Project and a report prepared. During the preparation of the Ghana Barriers Analysis Report (BAR), the national stakeholders through the participatory process, selected four prioritized technologies each from the agricultural and the water sectors.

With regards to the agricultural sector, the prioritized technologies were the following:

- (i) Rainwater collection from ground surfaces ó small reservoirs;
- (ii) Post construction support (PSC) for community managed water systems;
- (iii) Protected wells resilient to flooding; and
- (iv) Demarcation and protection of riparian buffer zones

The prioritized technologies in the agricultural sectors are given below:

- (i) Integrated Nutrient Management;
- (ii) Community Based Extension Agents;
- (iii) Water Users Association; and
- (iv) Ecological Pest Management

After the draft Barrier Analysis Report (BAR) was completed, the experts sent copies to the stakeholders and all the members of the National Climate Change Committee (NCCC) for their inputs which were later incorporated into the BAR.

There were common barriers for all the identified technologies. For example in the agricultural sector, current policies were inadequate regarding agricultural extension, and the same barrier was identified in the water sector. Furthermore, the misconception of the farmers about the technologies was derived from low awareness and mis-understanding of the

objectives of the technologies. In the water sector, low level of expertise has contributed to water resources systems becoming dysfunctional. Indeed, under all the selected technologies, low technical capacities of end-users of the technologies have been identified as one major barrier which needs to be addressed.

The TNA Project and specifically the barrier analysis and related outputs have shown that there is need for a holistic approach to the transfer and diffusion of technologies not only in Ghana but Africa as a whole.

In this regard, there is the need for African Governments to commit themselves to allocating substantial resources to climate change adaptation. Effective resource allocation could go a long way in addressing current issues relating to barriers in technology diffusion.

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20th March, 2013

LIST OF ABBREVIATION AND ACRONYMS

CBEA	-	Community Based Extension Agents
CBO		Community Based Organisation
CWSA		Community Water and Sanitation Agency
EPM		Ecological Pest Management
FBOs		Farmer-Based Organisations
GDP	-	Gross Domestic Product
GRA		Ghana Revenue Authority
GSGDA	-	Ghana Shared Growth and Development Agenda
INM	-	Integrated Nutrient Management
IPM		Integrated Pest Management
ISFM	-	Integrated Soil Fertility Management
MoFA	-	Ministry of Food And Agriculture
MLGRD		Ministry of Local Government and Rural Development
MOU		Memorandum of Understanding
MWRWH	-	Ministry of Water Resources, Works and Housing
NCCAS	-	National Climate Change Adaptation Strategy
NDPC		National Development Planning Commission
NGOs	-	Non ó Governmental Organizations
PCS	-	Post - Construction Support
RELCs		Research Extension Linkage Committees
SSA		Sub-Saharan Africa
TNA	-	Technology Need Assessment
UNDP		United Nations Development Program
WHO		World Health Organisation
WRC	-	Water Resources Commission
WUA		Water User Association

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Executive Summary

Barrier analyses were undertaken to identify potential barriers to the diffusion of prioritised technologies in the water and agricultural sectors in rural communities in Ghana. Identified barriers were analysed using barrier trees. Measures to overcome the barriers were also identified and analysed by means of measures trees. The processes of barrier and measures identification and analyses were carried out through stakeholder consultations, expert knowledge and available literature.

Four water sector and four agricultural sector technologies were considered. These were prioritised from a previous stakeholder consultation process undertaken for that purpose. The prioritised technologies in the water sector are as given below.

- i. Rainwater collection from ground surfaces ó small reservoirs;
- ii. Post construction support (PCS) for community managed water systems;
- iii. Protected wells resilient to flooding;
- iv. Demarcation and Protection of Riparian Buffer Zones.

All four water technologies are community based targeting those most vulnerable to the impacts of climate change on water resources. All have been classified as non-market publicly provided goods. Thus, government actions in promoting and facilitating the diffusion and adoption of these technologies are paramount. In addition, the capacities of beneficiary communities to adopt and manage the technologies both for their wellbeing and for sustainability are a prerequisite.

Common barriers to the adoption of the technologies in the water sector include:

- High maintenance cost of the technologies as a result of high cost of labour, technical services, equipment and materials;
- Inadequate funding for sustaining the technologies due to insufficient public investment, external funding and private sector funding;
- Inadequate community and local (district) level capacity to keep the technologies functional, including technical and financial management expertise;
- Inadequate integration of the technologies in policy plans resulting in their poor diffusion and adoption;

- Lack of cultural acceptance of change so communities are not motivated to adopt the technologies whole heartedly;
- Inadequate community development specialists and logistics to design and implement appropriate community educational and awareness-raising programs in beneficiary communities;
- Incoherent government policy on climate change to drive the adoption of the technologies.

The Enabling framework for overcoming the identified barriers in the water sector includes the following components:

- Development and operationalization of a coherent government policy framework on climate change to facilitate the recognition of the technologies as essential mechanisms to increase the resilience of vulnerable communities to the impacts of climate change on water availability. Provision of water in adequate quantities and quality to communities and their empowerment to own and sustainably manage the resource should be recognized as not only a developmental issue but also an adaptation to climate change impacts. A policy framework that takes this into account and which specifies the institutional and stakeholder arrangement together with the technologies that need to be deployed for a climate resilient socio-economic development is, therefore, essential. Such a framework should be an integral part of the overall development agenda of government. The development and operationalization of the policy framework would be the duty of both government and parliament. It should lead to increased budgetary allocation in support of the diffusion of the technologies and the facilitation of the involvement of external agencies with requisite know-how and other resources.
- A stable micro- and macro-economy with stable exchange rates, low interest rates, favourable import duties and tax relief incentives targeted at the importation, production and supply of equipment and materials for the diffusion of the technologies will reduce costs considerably and encourage private participation in delivery, diffusion and uptake of these technologies.
- The existence of the necessary expertise, specialists and logistics at the National, Regional and District (local) levels to adequately animate, train, monitor and supervise communities to get them to assume ownership of the technologies and

empower them to effectively manage the technologies and derive optimum benefit from them **(see Measures Tree for Rainwater Collection from Ground Surfaces under A in Annex I)**.

For demarcation and protection of riparian buffer zones (Technology iv), in particular, a proper and legal land acquisition system would have to be put in place beforehand to acquire other lands so that those from whom lands will be taken to implement the technology can be given lands to support their livelihoods. In addition, an elaborate policing mechanism would have to be instituted to not only monitor encroachments of buffer zones but also to apprehend and prosecute offenders. This would provide the necessary framework for effectively protecting demarcated buffer zones.

The prioritised technologies in the agriculture sector are as given below:

- i. Integrated Nutrient Management
- ii. Community Based Extension Agents
- iii. Water Users Association (WUA)
- iv. Ecological Pest Management

All four agriculture sector technologies are community based targeting rural farming households who are most vulnerable to climate change impacts on agriculture and food security. All have been classified as non-market publicly provided goods. Whilst government will be responsible for facilitating the diffusion and adoption processes of these technologies; the capacities of farmers and farmers' groups in beneficiary communities to adopt and uptake the technologies are paramount to achieving improved food security, poverty reduction and resilience within these communities.

Common barriers to the adoption of the technologies in the agriculture sector include:

- Inadequate extension service delivery as a result of high farmer to agricultural extension staff ratio which is a result of national policy on public sector employment.
- Weak research-extension linkages resulting in limited capacity of extension staff.
- Inadequate community and local (district) level capacity, including technical skills resulting in low adoption of technologies
- Inadequate integration of the technologies in policy plans resulting in their poor diffusion and adoption.
- Misconception of technologies brought about by inadequate awareness creation about the potential of the technologies.

- Incoherent government policy on climate change to drive adoption of the technologies.

The Enabling framework for overcoming the identified barriers in the agriculture sector includes the following components:

- Prioritization of climate change as an important development and cross-cutting issue that has implications for the sustainability of the food and agriculture sector; and subsequent development of strategies and /or mechanisms to increase productivity whilst building resilience within the sector. This will provide opportunity for prioritizing these technologies for promotion, adoption and uptake. It should lead to increased budgetary allocation in support of the diffusion of the technologies and the facilitation of the involvement of external agencies with requisite know-how and other resources.
- Deepening of the national decentralization process to enable strengthening of decentralized departments including the extension services with well qualified staff to provide necessary technical support to field extension agents to adequately animate and train farmers to derive optimum benefits from their undertakings. Additionally, the districts could, depending on their requirements engage additional staff to boost current numbers or could establish operational MOUs with not-for-profit organizations to complement the government extension service delivery efforts.
- Stable macro-economy that continues to grow with a GDP rate of not less than 8 per cent with contributions from the agriculture not below current levels (27 ó 30 per cent). This will enable the continuous recognition of the importance of agriculture sector to the national development and will provide opportunity for addressing issues e.g. low extension staff numbers and inadequate budgetary allocations to the sector affecting the development of the sector. Indeed, African governments including Ghana have committed themselves to allocating not less than 10 per cent of annual budgetary allocations to agriculture. Achievement of this target could go a long way to address current issues relating to financing of the sector

There are inter-connections in these barriers. The prioritisation of the climate change is an essential step in getting the relevant institutions to act especially at the district level where action matters most. Yet, the formulation of action plans and their implementation by the respective agencies depends a great deal on public investment and resource allocation. It implies that barriers have to be holistically addressed for effectiveness.

1 Water Sector

1.1 Preliminary targets for technology transfer and diffusion

The preliminary targets for the deployment of each selected technology in the water sector are the small rural communities in the most climate-stressed regions of the country. For Ghana, these areas are mainly in the Northern regions of the country and the Savannah ecological zones. The poverty incidence of the human populations in these areas is also some of the highest in the country (NDPC & UNDP, 2010).

According to WHO (2012), rigorous cost-benefit analyses shows that economic returns are at least two-fold for investments in drinking-water supply globally and regionally such as for Sub-Saharan Africa (SSA). While similar studies at the country level such as for Ghana are not readily available, the extra benefits of multi-use water systems as envisaged in the technologies being considered here for diffusion, could result in higher benefits to cost ratios. Apart from meeting the water requirements of beneficiary communities, these water sector technologies will also provide environmental benefits and in the case of the demarcation and protection of riparian buffer zones technology in particularly, biodiversity and environmental integrity will also be enhanced. The cost-benefit analysis provided for 2 technologies in the water sector lists the potential cost sources and possible benefits as identified with the stakeholders. No monetary values have been assigned to the benefits as the needed information is not available. However, the estimated overall cost for diffusing each of the 2 technologies to a targeted number of households is given.

1.2 Barrier analysis and possible enabling measures for Rainwater Collection from Ground Surfaces (small reservoirs)

All the identified barriers and measures for each technology were grouped under the following categories by the stakeholders consulted following the guidelines in Boldt *et al.* (2012).

- a. Institutional
- b. Technical
- c. Socio-Cultural
- d. Economic and Financial

Barriers and measures grouped under a-c constitute the non-economic barriers. It should be pointed out at the outset that there are economic/financial considerations inherent in the non-

economic barriers as these cannot be fully overcome without financial resources. Therefore, the categorisation of the barriers should be considered broad with overlaps.

All four technologies were classified as non-market public goods by the stakeholders. Barrier and measures trees were used to analyse the barriers and measures identified. Separate trees were constructed for the starter problem/solution and for each of the four barrier groups listed in a-d above.

It should be emphasized from the outset that all 4 technologies are being adopted at various levels in the country. Apart from the Demarcation and Protection of Riparian Buffer Zones which is relatively new and is currently being promoted by the WRC, the rest are well known in the country. The problem is that these technologies have not been implemented widely and sustainably enough to bring lasting benefits to water-stressed populations of the country. Therefore, the problems identified for the barrier analysis are not problems due to the LACK of deployment of the technologies but due to the INADEQUACY in the deployments - in quantity, quality and sustainability terms. Thus, while the Ministry of Water Resources, Works and Housing (MWRWH) through the Community Water and Sanitation Agency (CWSA) provides potable water to rural communities of the country through borehole systems, the supply is currently grossly inadequate with nearly 40% of these communities not covered by the CWSA systems as at 2011 (.GWF, 2011). In addition, they are usually single-use (domestic purposes) systems only and are not adequate to be also used for income generating purposes. Multi-use water systems such as small reservoirs and dugouts exist throughout the country but these are small in numbers with most of them poorly managed or maintained due to lack of adequate funds for the purpose (some funds are made available but these are often not enough and are not released in a timely manner). In addition beneficiary communities are usually not actively involved in the planning, construction and maintenance of these multi-use systems with the result that they deteriorate and become dysfunctional thereby depriving the affected communities of the benefits of the systems (Regassa et al., 2011). Thus inadequate water systems and poor or ineffective water management are real problems in the water sector.

1.2.1 General description of technology

This technology covers collection, storage and use of rainfall that lands on the ground as opposed to collection from roofs. In many water-poor areas, small-scale runoff collection

infrastructure can contribute greatly to the volume of freshwater available for human use. This is especially true in arid and semi-arid regions, where the little rainfall received is usually very intense and often seasonal (Elliot et. al., 2011). Because of this, runoff and river flows can be abundant for brief periods and non-existent throughout the rest of the year, as is the case in Northern Ghana. Rainwater collection from ground surfaces is typically used in areas with seasonal rainfall to ensure that adequate water is available during the dry season.

The technology consists essentially of collecting flows from a river, stream or other natural watercourse (sometimes called floodwater harvesting). This technique often includes an earthen or other structure to dam the watercourse and form small reservoirs.

Rainwater collection from ground surfaces contributes to climate change adaptation at the community level by providing a convenient and reliable water supply during seasonal dry periods and droughts.

1.2.2 Costs and benefits associated with transfer of the technology

Potential sources of costs associated with transfer and diffusion of Rainwater Collection from Ground Surfaces are as follows:

- Identification of sites suitable for constructing small reservoirs and dugouts
- Design of the reservoirs including intakes, offtakes and access points
- Construction of the reservoirs
- Mobilization and education of beneficiary communities and their involvement in all aspects of the technology diffusion
- Technical and financial management training of water management teams in the communities to be responsible for the proper operation, management and maintenance of the water facilities
- Provision of starter capital to the management teams as post technology diffusion support towards maintenance
- Institutional support from public organizations such as the Ministry of Water Resources Works and Housing (MWRWH) and the Ministry of Local Government and Rural Development (MLGRD) and Community Based Organisation (CBOs).

From the interaction with stakeholders, the cost of actions for the transfer and diffusion of this technology to about 50,000 households in the semi-arid Savanna regions of Northern and Coastal Ghana is estimated at US\$ 22.2 million. This cost consists of the cost of constructing 100 small reservoirs and dugouts to provide the targeted households with water in the dry season for multiple uses (US\$ 200,000 per reservoir), training of the households in the technical and financial management of the systems and strengthening the local District Assemblies to monitor and supervise the beneficiaries to ensure effective and efficient management, maintenance and use of the water systems (US\$ 22,000 per reservoir).

Potential benefits associated with Rainwater Collection from Ground Surfaces are as follows:

- Increased availability of water for multiple uses
- Saving of time, particularly of women and children, from water collection for other activities
- Decreased incidence of water borne diseases
- Increased production of crops (e.g. vegetables) and livestock as there will be enough water for these all year round
- Improved household food security
- Improved household income
- Improved attendance at school, especially for the girl child
- Improved management and sustainability of water resources

1.2.3 Identification of barriers to the diffusion of the technology

The identified barriers for the technology were analysed using the problem tree. These are presented under A in Annex I. All barriers were identified and analysed based on stakeholder consultations and the experts own knowledge. The starter problem for this technology was insufficient water to support livelihoods of rural communities resulting in poor community health and poor school attendance, particularly for the girl-child.

1.2.3.1 Economic and financial barriers

Economic and financial barriers were mainly high construction and maintenance cost and high cost of feasibility studies. As indicated in the Economic/financial barrier tree analysis under A in Annex I, important root causes are few technical experts and artisans at the local

level to undertake construction of the water system in a cost effective manner. In addition, high import tariffs (up to 20% depending on the item imported, (GRA, 2011).), high interest rates (above 20%) and unstable exchange rate (from cedi/dollar rate of about 1.64/1 in January 2012 to about 1.90/1 in December, 2012, FreeCurrencyRates.com (2012)) result in high cost of production and imports of construction materials and equipment. Also there is not enough support from government (such as tax reduction incentives) to suppliers of these materials and equipment, particularly at the local level, resulting in inadequate supplies and high prices. For example, cement cost higher in the rural areas than in the urban areas because of transportation cost, lower demand in the rural arrears and other factors. There are no tax exemptions for making these inputs available in the rural areas and so few suppliers are motivated to sell in these areas.

1.2.3.2 Non financial barriers

Institutional barriers identified were lack of community ownership of the water system, conflicting or unharmonised sectoral policies (eg, provision of water for agricultural purposes only (agriculture sector concern) and not for water supply (water sector concern)) on the promotion of the technology and inadequate integration of the technology in policy plans. This results in the weakening of the driving mechanisms from government agencies in pushing for the widespread adoption of the technology. In particular, conflicting or unharmonised sectoral policies on the technology (eg. NWP (2007) mainly concerned with municipal water supply only and not also agriculture) result in an uncoordinated effort in the promotion of the technology. Root causes of the institutional barriers are few community development specialists with little logistics to be able to design and implement appropriate community educational and awareness-raising programs in beneficiary communities and incoherent government policy on climate change to drive the adoption of the technology. Lack of awareness raising in beneficiary communities means they are not animated enough to accept the technologies as their own ó a prerequisite to successful diffusion of the technology. .

Water systems provided for single use only (e.g. for domestic only and not also for agriculture) and inadequate capacity of users (in technical and financial management) to properly manage the technology were identified as technical barriers to the technology. Provision of systems for single water use only means there is no flexibility in such systems to support other water uses that might contribute to the incomes of beneficiary communities later. In other words, the technology that supports multipurpose use by beneficiaries would

be more likely to be readily accepted and maintained than that supporting single purpose use only. Sustainability of the technology would not be easily achieved if the communities do not have the necessary capacity both in terms of know-how and material resources to adequately manage it. The root causes are inadequate consideration of community needs in the design and delivery of the technology and inadequate technical and financial management expertise at the local level for the provision of the necessary support to communities to effectively manage the technology and make it sustainable.

For socio-cultural barriers, poor sanitation practices (such as open defaecation) polluting the environment and resulting in poor quality of collected runoff water, lack of cultural acceptance of change and bias against women and other vulnerable groups in the management and use of the water systems were identified. Women are major stakeholders in water resources use and management. Socio-cultural biases against them in decision making and implementation in rural communities could result in the technology not benefiting them and other vulnerable groups in the communities. Lack of cultural acceptance of change means that beneficiary communities could resist the adoption of the technology for no technical reason. The root causes of the socio-cultural barriers are largely inadequate technical expertise and logistics at the local level to properly animate communities and raise their awareness.

1.2.4 Identified measures

Measures were also identified and analysed based on the stakeholder consultations, the expert's own knowledge and research. The measures were analysed by means of measures trees (A, Annex I).

1.2.4.1 Economic and financial measures

Financial measures hinged mainly on the need for government action to reduce cost of supply of dam construction materials and equipment through reduction in interest rates to less than 20% , reduction of import duties, stabilization of the exchange rate and institution of tax relief incentives to suppliers of these materials and equipment.

1.2.4.2 Non financial measures

One measure identified to overcome the institutional barriers was the recruitment and training of more community development specialists at the local level to animate and raise the awareness of communities sufficiently to enable them assume ownership of the deployed technology. Another measure was the development and operationalization of a coherent

government policy framework on climate change to provide support to the technology as an important mechanism to increase the resilience of vulnerable communities to the impacts of climate change on water availability.

For measures to address technical barriers, it would be necessary to improve the technical capacity of local consultants through appropriate training so they could take into account the need for the technology to satisfy multiple and not just one need. Another measure is ensuring that the necessary expertise, specialists and logistics are available at the local level to provide the necessary training that will enable beneficiary communities manage the technology and derive optimum benefit from it.

To overcome the socio-cultural barriers effective educational programs need to be undertaken in the communities to raise their awareness. This means community development experts would have to be engaged at the local level and provided with the necessary logistics, materials and financial incentives to enable them undertake this educational task..

1.3 Barrier analysis and possible enabling measures for Post construction support for community managed water systems

1.3.1 General description of technology

The community that can adequately manage its own water supply system over the long term without any form of external assistance is the exception rather than the rule. Post-construction support (PCS) can increase the success and sustainability of community-managed water systems. This is even true for those systems that are implemented according to all the currently recognized best practices of the demand-driven, community-managed model. PCS is typically carried out through government programs, municipalities and other bodies that provide community-managed water systems. Types of PCS include, but are not limited to (Elliot et. al, 2011):

- Technical training for water system operators
- Technical and engineering support, including provision of technical manuals
- Financial and accounting assistance (e.g. setting tariffs)
- Help with settling disputes (e.g. bill payment or water sources)
- Help with maintenance, repairs and finding spare parts

- Assistance in finding external funding for O&M, expansion or repairs
- Assistance in assessing the sufficiency of supply for expansion or in the case of drought
- Start-up capital for emergency system repairs
- Household visits to residents to discuss water system use.

PCS contributes to climate change adaptation at the community level through:

- a) Diversification of community water supply
- b) Promotion of water conservation, and
- c) Increased resilience to water quality degradation.

PCS can empower community water committees and operators to access the financial, management and technical resources that enable utility-managed supplies to prepare for and adapt to adverse precipitation conditions.

PCS facilitates community ownership, management and maintenance of water systems, promotes women participation in their management and improves system performance and sustainability.

1.3.2 Costs and benefits associated with transfer of the technology)

Potential sources of costs associated with transfer and diffusion of Post Construction Support include the following:

- Identification of water systems needing support
- Mobilization and education of beneficiary communities and their involvement in all aspects of the technology diffusion
- Technical and financial management training of water management teams in the communities to be responsible for the proper operation, management and maintenance of the water facilities
- Provision of starter capital to the management teams for maintenance and emergency repairs of supported water systems
- Institutional support from public organizations such as the Ministry of Water Resources Works and Housing (MWRWH) and the Ministry of Local Government and Rural Development (MLGRD) and Community Based Organisation (CBOs).

From the interaction with stakeholders, the cost of actions for the transfer and diffusion of this technology to about 500 rural communities throughout Ghana (i.e., in all 10 Regions of the country) is estimated at US\$ 9.0 million. The aim of such a transfer would be to strengthen the technical and financial capacity of beneficiary communities to better manage their existing multi-use water systems in a sustainable manner. The amount stated above covers the cost of two main interventions. The first is animating, training (in technical and financial management) and providing the communities with starter capital for proper management of their systems (US\$ 13,000 per community). The second is strengthening the local District Assemblies and instituting management systems including co-ordination, monitoring and evaluation at all levels ó community, district, regional and national - to monitor and supervise the beneficiaries to ensure effective and efficient manangement, maintenance and use of the water systems (US\$ 5,000 per community).

Potential benefits associated with Post Construction Support include:

- Continuous availability of water for multiple uses
- Increased access to good quality water
- Saving of time, particularly of women and children, from water collection for other activities
- Decreased incidence of water borne diseases
- Increased production of crops (e.g. vegetables) and livestock as there will be enough water for these all year round
- Improved household food security
- Improved household income
- Improved attendance at school, especially for the girl child
- Improved management and sustainability of water resources

1.3.3 Identification of barriers for technology

The identified barriers for the technology were analysed using the problem tree. These are presented under B in Annex I. All barriers were identified and analysed based on stakeholder

consultations and the experts own knowledge. The starter problem for this technology was poorly managed community water systems resulting in reduced accessibility of communities to good quality water, increased poverty and general poor community health and wellbeing.

1.3.3.1 Economic and financial barriers

The main economic and financial barrier was inadequate funds available to communities for emergency repairs and general maintenance of their water systems. This results directly from high maintenance costs (as compared to incomes of rural households) and inadequate access of communities to financial resources. As indicated in the Economic/financial barrier tree analysis under B in Annex I, the important root causes include inadequate financial support from government and inadequate government facilitation for support from external agencies resulting in little participation of these agencies in the adoption of the technology. In addition high import tariffs, interest rates and unstable exchange rates (as indicated in the technology 1 above) result in high cost of production and imports of materials for maintaining the water systems. Also insufficient support from government to spare parts suppliers (such as tax reduction incentives) leads to high prices.

1.3.3.2 Non financial barriers

The institutional barriers to the diffusion of this technology are conflicting sectoral policies (e.g. planning for facilities for agriculture only or water supply only) resulting in lack of co-ordination in the implementation of the technology, ineffective management teams at the community level as result of inadequate involvement of communities in implementation of technology and also weak local or district level institutions incapable of effectively driving the management process. Another institutional barrier is inadequate integration of the technology in policy plans resulting in insufficient support from government and other agencies in driving the processes for its implementation.

Technical barriers include untimely maintenance of water systems by communities due to lack of adequate technical and financial capacity. The root causes of this barrier are inadequate technical and financial management expertise at the local level to empower communities to effectively manage the technology as an important contribution to its sustainability.

For socio-cultural barriers, community reluctance to self manage their water systems and bias against women and other vulnerable groups in the management and use of the water systems

were identified. The root causes are inadequate community development specialists and logistics to design and implement appropriate community educational and awareness-raising programs in beneficiary communities.

1.3.4 Identified measures

Measures were also identified and analysed based on the stakeholder consultations, the experts own knowledge and research. The measures were analysed by means of measures trees (B, Annex I).

1.3.4.1 Economic and financial measures

Financial measures hinged mainly on the need for government action to attract external support for the effective implementation of the technology, reducing cost of supply of materials and equipment through reduction in interest rates and import duties and also instituting tax relief incentives to suppliers of these materials and equipment.

1.3.4.2 Non financial measures

A key institutional measure identified was the development and operationalization of a coherent government policy framework on climate change recognising the technology as an important mechanism to increase the resilience of vulnerable communities to the impacts of climate change on water availability. Such a policy framework should provide sufficient institutional arrangement for sectoral policy harmonisation and strong local institutions to form, monitor and supervise management teams at the community level.

Technical measures should aim at ensuring that the necessary expertise and logistics are available at the local level to give communities the necessary technical and financial management training to enable them use and manage the technology adequately and derive optimum benefit from it. In addition, government should encourage the involvement of external agencies in the technology dissemination and sustenance.

Community development specialists would be required to properly animate communities and raise their awareness in order to overcome the socio-cultural practices.

1.4 Barrier analysis and possible enabling measures for Protected wells resilient to flooding

1.4.1 General description of technology

Increasing access to groundwater is a key strategy for household water supply (both potable and nonpotable), particularly in rural communities. Access to groundwater is critical during drought. Therefore, water supply schemes and drought relief programs in rural areas typically incorporate drilling or deepening of tubewells and/or boreholes (Elliot et. al, 2011).

Protected wells can potentially provide a water supply that is highly resilient to flooding. . Flooding can lead to contamination of drinking water wells and can also prevent physical access when floodwaters are high enough. Protecting wells against flooding is an effective mechanism to reduce the vulnerability of communities during flood events. However, improper design and construction can make wells vulnerable during flooding. The key vulnerabilities of wells during flooding are: (1) ingress or infiltration of contaminated waters; (2) lack of wellhead access due to flood waters; and (3) collapse of unlined hand dug wells when soil becomes saturated. Protected wells can include tubewells, boreholes and hand-dug wells.

The salient features of all protected wells include the following: (1) a concrete apron to direct surface water away from the well; (2) a sanitary seal (normally clay, grout, and concrete) that extends at least 1-3 m below ground to prevent infiltration of contaminants; and (3) a method to access water that enables it to be sealed following use.

The technology includes sanitary surveys of wells to identify key vulnerabilities related to flooding.

In addition to protection of wells currently used for drinking water, sealing abandoned wells is also essential to protecting groundwater quality in flood zones. If an abandoned well is not properly sealed, floodwaters that inundate the abandoned well are likely to contaminate both shallow and deep groundwater.

1.4.2 Identification of barriers for technology

Based on stakeholder consultations and the experts own knowledge, the following barriers for the technology were identified and analysed. The starter problem for this technology was community wells and boreholes highly vulnerable to flooding resulting in reduced access to good quality water during floods and leading to poor household/community health and

wellbeing. The identified barriers for the technology were analysed using problem trees. These are presented under C in Annex I.

1.4.2.1 *Economic and financial barriers*

Two main economic and financial barriers were identified. One was high construction and maintenance cost (as compared to incomes of rural households) of protected wells as a result of high cost of labour, technical services and construction equipment and materials. The other was inadequate funding for sustaining the technology as result of insufficient public investment and private participation.

As indicated in the Economic/financial barrier tree analysis under C in Annex I, the important root causes are few technical experts and artisans at the local level and fees for technical services and local artisans not standardized so that the services of these experts and artisans are too expensive in the communities. Other root cause are low prioritisation of the technology in the country's development agenda and poor engagement of the private sector by the Ministry of Water Resources Works and Housing (MWRWH) to enable them contribute more meaningfully to diffusion and adoption of the technology. As in the previous 2 technologies high import tariffs, high interest rates and unstable exchange rate resulting in expensive imports and high production costs of equipment and materials are also root causes. In addition, not enough support by government to suppliers of construction equipment and materials through such mechanisms as income tax relieves is an important root cause.



***Photo:** Participants at the Stakeholders' Consultation Workshop on Barrier Analysis. Those seated are from right Dr. George O. Essegbey, Lead Expert, Dr. Regina Sagoe of Crops Research Institute, Mr. E. Siisi- Wilson the Chairman of the EPA Management Board and Mr. Djimingue Nanasta of ENDA*

1.4.2.2 Non financial barriers

The institutional barriers identified are inadequate community structures to monitor and maintain well protection, lack of monitoring teams at the district level to ensure the structures are well constructed and maintained and the technology not routinely considered in provision of wells and boreholes due to inadequate integration of technology in policy plans. Again, a missing coherent government policy framework and inadequate community development specialists at the local level are root causes.

Wells overused due to their inadequacy to meet community needs (resulting from poor design and siting) and inadequate capacity of users to manage the technology are key technical barriers to the diffusion of this technology. Root causes of these barriers are poor technical capacity of local consultants in good system design, inadequate technical and financial management expertise at the local level to effectively manage the technology and make it sustainable and insufficient technical expertise at the district or local level to provide backup support to beneficiary communities.

The socio-cultural barriers are poor attitudes of communities to maintenance of protected wells and lack of cultural acceptance of change so communities are not motivated to adopt the technology. The root causes are inadequate community development specialists and logistics to design and implement appropriate community educational and awareness-raising programs in beneficiary communities.

1.4.3 Identified measures

Measures were also identified and analysed based on the stakeholder consultations, the experts own knowledge and research. The measures were analysed by means of measures trees (C, Annex I)

1.4.3.1 Economic and financial measures

Economic and financial measures require government action to reduce cost of construction materials and equipment through reduction in interest rates and import duties and

introduction of tax relief incentives to suppliers of these materials and equipment. In addition, government should give high priority to the technology in its development plans, allocate more funds and entice the private sector to effectively participate in the adoption and sustenance of the technology. A sustained engagement of the private sector by government is required to identify the mechanisms and the incentive regimes that are necessary to secure the sector's involvement in the technology diffusion.

1.4.3.2 Non financial measures

Institutional measures identified included the development and operationalization of a coherent government policy framework on climate change to promote the technology as an important mechanism to increase the resilience of vulnerable communities to the impacts of climate change on water availability. Such a policy framework should provide sufficient institutional arrangement for strong local institutions to form, monitor and supervise management teams at the community level.

Technical measures involve providing sufficient technical expertise and logistics at the district level through recruitment and training. This will make available at the local level the requisite capacity to provide the necessary training to communities to enable them manage the technology effectively and derive optimum benefit from it. In addition, government should, through the Ministry of Water Resources Works and Housing, support the improvement of technical capacity of local consultants through training to enable them design the systems properly and make them attractive to beneficiary communities.

A key socio-cultural measure is ensuring that the necessary specialists and logistics are available at the local level to properly animate, educate and raise the awareness of communities.

1.5 Barrier analysis and possible enabling measures for Demarcation and Protection of Riparian Buffer Zones

1.5.1 General description of technology

Human induced activities such as uncontrolled logging and mining activities, human settlements, urbanization, livestock populations, and poor agricultural practices have degraded the vegetative cover at headwaters and along the banks of many river systems and other surface water bodies (WRC, 2011). These poor and unsustainable management practices

are jeopardizing the physical quality of the environment, the hydrological and ecological support systems and the livelihoods of local inhabitants around these water bodies. These activities have further exposed most of Ghana's rivers and water bodies to the vagaries of the weather, and may as a result, account for the many streams and rivers, which used to be perennial, but are now experiencing periodic drying up.

The creation and protection of Buffer Zones for water bodies are intended to control these human induced activities in the vicinity of the bodies, protect, regenerate and maintain the native/ established vegetation in the zones to improve water quality, maintain the functionality of the water bodies and ensure the sustenance of the ecological and socio-economic functions of the zones.

Buffer zones refer to the existence of physical areas that separate either two ecological systems or an ecological system from other land uses or that border a water body. The functional aspect of Riparian Buffer Zones can be categorized into natural (ecological) and human (socio-economic) services.

1.5.2 Identification of barriers for technology

Based on stakeholder consultations and the experts own knowledge, the following barriers for the technology were identified and analysed. The starter problem for this technology was low adoption of buffer zones for protection of water bodies resulting in impairment of both ecological and socio-economic functions of riparian zones. These lead eventually to increased threat to riverine biodiversity and general poor community health and wellbeing. The identified barriers for the technology were analysed using problem trees. These are presented under D in Annex I.

1.5.2.1 Economic and financial barriers

The main economic and financial barrier is inadequate supplies of planting material to demarcate buffer zones. This results directly from the high cost of the planting materials and too few producers engaged in their production.

As indicated in the Economic/financial barrier tree analysis under D in Annex I, the important root causes are the non-standardisation of labour costs and technical fees to reduce cost of producing the planting materials and insufficient engagement of driving institutions

such as the Water Resources Commission (WRC) and the Ministry of Food and Agriculture (MoFA) to promote private and community participation in the production of these materials.

1.5.2.2 Non financial barriers

The institutional barriers identified are inadequate integration of technology in policy plans due to lack of proper policy mechanisms to promote the diffusion and adoption of the technology, conflicting sectoral policies resulting in lack of clarity in the mechanisms to promote the adoption of the technology and inefficient use of resources and inadequate policing mechanisms to protect demarcated buffer zones. The root causes are incoherent government policy on climate change to drive the adoption of the technology and appropriate legal processes for riparian buffer zone policy operationalisation not carried through by WRC, MWRWH and parliament even though a draft policy has been prepared.

Technical barriers are insufficient technical capacity at the national, local and community levels to demarcate and manage riparian buffer zones and inadequate technical capacity in communities to produce and use buffer zone planting materials. The root cause is insufficient recruitment and training of the necessary technical staff at the national, local and community levels.

The socio-cultural barriers identified are lack of community acceptance of buffer zones due to use of inappropriate planting materials and conflicts in use of land proposed for buffer zones; and sidelining of women and other vulnerable groups in the diffusion and uptake of the technology. These result directly from inadequate use of traditional knowledge and identifying suitable planting materials and insufficient community awareness raising. The root causes are inadequate community development specialists and logistics to design and implement appropriate community educational and awareness-raising programs in beneficiary communities, limited land available for other uses and undeveloped alternative livelihoods for those who lose their land to buffer zones.

1.5.3 Identified measures

Measures were also identified and analysed based on the stakeholder consultations, the experts own knowledge and research. The measures were analysed by means of measures trees (D, Annex I)

1.5.3.1 Economic and financial measures

Economic and financial measures identified were the need to standardize cost of labour and technical services in order to reduce the cost of production of planting materials for buffer zone demarcation and also the need for the driving institutions (WRC, MoFA) to seriously engage with the private sector in order to provide it with the necessary incentives such as tax exemptions, to enable it participate meaningfully in the diffusion of the technology. In addition, sufficient budgetary allocation should be made so that this together with the contribution from a well animated private sector would lead to adequate production of planting materials.

1.5.3.2 Non financial measures

Institutional measures identified included the development and operationalization of a coherent government policy framework on climate change to promote the technology as an important mechanism to increase the resilience of vulnerable communities to the impacts of climate change on water availability. Such a policy framework (which is currently non-existent) should provide the institutional arrangement for harmonised sector policies and adequate integration of the technology in development plans. The WRC, MWRWH and Parliament should expedite action to legalise the existing draft buffer zone policy and make it operational. This will facilitate the diffusion of the technology levels for adequate monitoring and supervisory services to communities.

The key technical measure includes the recruitment and training of sufficient technical staff at national, district and river basin authority. For socio-cultural interventions, one measure is ensuring that the necessary technical expertise, specialists and logistics are available at the local level to properly animate communities and give them the necessary training to enable them manage the technology and derive optimum benefit from it. Since land earmarked for buffer zones would usually be in use by sections of the communities, it would be necessary to make other lands available to these sections through proper acquisitions. Also, alternative livelihoods would have to be developed for affected communities. These measures will help to avoid conflicts in the use of the lands reserved for buffer zones and ensure the co-operation and active participation of the communities in the preservation of demarcated zones.

1.6 Linkages of the barriers identified

Sections 1.1 to 1.5 above show several common characteristics of the prioritised technologies and identified barriers. Each technology is community based targeting those most vulnerable to the impacts of climate change on water resources. Another common feature is that all 4 technologies have been classified as non-market publicly provided goods. Thus, government actions in promoting and facilitating the diffusion and adoption of these technologies are paramount. In addition, the capacities of beneficiary communities to adopt and manage the technologies both for their wellbeing and for sustainability are a prerequisite. Common barriers to the adoption of the technologies include

- High maintenance cost of the technologies as a result of high cost of labour, technical services, equipment and materials.
- Inadequate funding for sustaining the technologies due to insufficient public investment and private participation, including contributions from external agencies.
- The low level of community and local (district) capacity, including technical and financial management expertise, to keep the technologies functional.
- Inadequate integration of the technologies in policy plans resulting in their poor diffusion and adoption.
- Lack of cultural acceptance of change so communities are not motivated to adopt the technologies whole heartedly.
- Inadequate community development specialists and logistics to design and implement appropriate community educational and awareness-raising programs in beneficiary communities.
- Incoherent government policy on climate change to drive the adoption of the technology.

Therefore, measures to overcome these barriers would contribute immensely to the widespread adoption and sustenance of all four technologies. The barriers are inter-linked. The inadequacy of funding results in the poor maintenance of the water resources systems in the communities. The low level of community and local capacity also links to the poor maintenance and the inadequate integration of the technologies in policy plans and therefore the limited diffusion and adoption of the technologies. Measures to counter the barriers therefore needs to be carried out in a holistic manner to create synergy.

1.7 Enabling framework for overcoming the barriers in the Water Sector

A key component of the enabling framework for overcoming the barriers to the diffusion of all 4 prioritised technologies is the development and operationalization of a coherent government policy framework on climate change to explicitly recognise the identified and prioritized technologies as essential mechanisms to increase the resilience of vulnerable communities to the impacts of climate change on water availability. This would be the duty of both government and parliament. Such a policy framework should provide for an institutional arrangement for harmonised sector policies on the use of water resources and integration of the technologies in development plans such as the Ghana Shared Growth and Development Agenda (GSGDA). This should lead to increased budgetary allocation in support of the diffusion of the technologies and the facilitation of the involvement of external agencies with requisite know-how and other resources. A stable micro- and macro-economy with stable exchange rates, low interest rates, favourable import duties and tax relief incentives targeted at the importation, production and supply of equipment and materials for the diffusion of the technologies will reduce costs considerably and encourage private participation in delivery, diffusion and uptake of these technologies. Another important component of an enabling framework is the existence of the necessary expertise, specialists and logistics at the National, Regional and District (local) levels to adequately animate, train, monitor and supervise communities to get them to assume ownership of the technologies and empower them to effectively manage the technologies and derive optimum benefit from them. Setting up water user associations in beneficiary communities will also be an important mechanism for sustaining all 4 technologies.

For enabling frameworks specific to individual technologies, particularly post construction support for community managed water systems (Technology 2) and demarcation and protection of riparian buffer zones (Technology 4) the following should be considered. Some form of post construction support is currently given to beneficiary communities under the CWSA rural community potable water supply programs. However, this is limited to management of wells and borehole systems. This needs to be extended to other systems such as small dams and reservoirs. This would require a thorough review of the current support mechanism with the view to filling in gaps, plugging loopholes, expanding it and increasing its sustainability. In diffusing the demarcation and protection of buffer zones technology, sections of communities are likely to be dispossessed of the lands providing their livelihoods.

A proper and legal land acquisition system would have to be put in place beforehand so as to acquire other lands so that those from whom lands will be taken to implement the technology can be given other lands to support their livelihoods. In addition, an elaborate policing mechanism would have to be instituted to not only monitor encroachments of buffer zones but also to apprehend and prosecute offenders. This would provide the necessary framework for effectively protecting demarcated buffer zones.

2 Agricultural Sector

2.1 Preliminary targets for technology transfer and diffusion

The preliminary targets for the prioritised technologies for the agriculture sector are specific for each technology although there could be areas of overlap

2.1.1 Integrated Nutrient Management

The primary targets for the transfer of INM within Ghana are small-scale farmers within rural communities with farming systems that support provision of alternative plant nutrient sources. It is expected the technology will be diffused basically within the three (3) northern regions that are most threatened by climate change. A total of 100,000 farmers in rural communities nationwide to be reached by the technology within a stipulated period of 5 years (2013 to 2017)

2.1.2 Community Based Extension

The technology will be targeted at two categories of beneficiaries; i.e. potential trainees and users of trainees' services (farmers).

The focus location for the transfer of the technology will be the northern savannah zone of the country with areas most threatened by climate change. It is expected that within a period of 5 years, Community Based Extension system will be fully operational in at least 10 communities within 6 districts. A total of 120 extension agents will be functional; providing service to at least 1,200 farmers. It is expected that in the medium to long term the ratio of farmers to extension agents under CBE will not exceed 500 to 1.

2.1.3 Water Users' Association

The transfer of this technology will be targeted at both communities and water resources. The major target locations for this technology are water stress areas (coastal savannah and northern savannah zones). The water resource targets will be both natural and constructed facilities. It is estimated that the technology will be piloted and fully functional in at least 10 districts within five regions including the 3 northern regions and the coastal savannah areas of the Volta and Greater Accra regions.

2.1.4 Ecological Pest Management

Ecological Pest Management as a climate change adaptation technology will primarily be targeted at areas prone to increasing pest populations and frequent outbreaks. In Ghana, the technology will be targeted at farming communities within the transitional zone, which is the main food production zone. The technology transfer, within five years, will cover four regions namely Volta, Eastern, Ashanti and BrongAhafo regions. A variety of crops including both food and cash crops (cocoa) will be targeted for the transfer of the technology during the period with not less than 2500 beneficiaries (farmers) across the country.

The stakeholders classified all four technologies as non-market public goods. Barriers and measures trees were used to analyse the barriers and measures identified. Separate trees were made for the starter problem/solution and for each of the four groups listed in a-d above

2.2 Methodology for analysis of barriers and enabling measures for transfer and diffusion of identified technologies

Identification and analysis of barriers to and enabling measures for transfer and diffusion of technologies are important for the effective deployment of a selected technology. In the agriculture sector the identification and analysis of barriers and measures are based on rural communities in the most climate stressed regions of the country. All barriers and measures for all technologies identified by stakeholders and the experts were grouped under the following categories.

- a. Institutional
- b. Technical
- c. Socio-Cultural

d. Economic and Financial

Barriers and measures grouped under a-c constitute the non-economic barriers although financial considerations are key to addressing them for effective technology diffusion and adoption.

2.3 Barrier analysis and possible enabling measures for Integrated Nutrient Management

2.3.1 Description of the technology

It is also referred to as Integrated Soil Fertility Management (ISFM). The technology aims at making efficient use of both synthetic and natural plant nutrient (organic) sources to enhance soil fertility towards improving and preserving soil productivity. The success of INM relies on the appropriate application and conservation of nutrients and transfer of knowledge to farmers. The technology enables the adaptation of plant nutrient and soil fertility management within a farming system on the basis of their specific characteristics. This is an important ingredient for climate change adaptation.

Integrated Soil Fertility Management in Ghana has been widely promoted. Although the National Soil Fertility Action Plan (1998) identifies the need for use of multiple nutrient sources for soil fertility enhancement. Although there is an appreciable availability of capacity at various levels for effective transfer of the technology to farmers; uptake of the technology is low compared to use of single nutrient sources.

Integrated Nutrient management as a soil fertility improvement and productivity enhancement technology has an added advantage of contributing to addressing climate by supporting both adaptation and mitigation. In terms of adaptation it provides opportunity for maximizing yields in good years whilst supporting moisture storage through improvements in soil organic matter contents.

Sustenance of good soil quality achieved through combined use of organic and inorganic plant nutrients reduces rate of soil degradation hence supports intensification thus reducing land use conversion which is a major source of Green house Gas emissions in Ghana. The

increased use of INM has the potential of increasing soil carbon stocks (sequestration) in the medium to long term.

2.3.1.1 *Cost and benefits of transfer and diffusion of Integrated Nutrient Management*

Potential sources of costs associated with the transfers and adoption of INM:

- Research and development of INM protocols
- Preparation of extension/dissemination materials e.g. factsheets
- Training of subject matter specialist/trainers within extension service
- Training of frontline extension agents
- Farmer level awareness creation e.g. demonstrations, posters, media discussions, mobile video etc.
- Farmer training and skills development
- Farmer **level investments into nutrient sources**

Potential benefits of the transfer and adoption of Integrated Nutrient Management are as follows:

- Improved soil quality; improved soil structure, aeration, water storage etc.
- Increased productivity and production
- Reduction in production costs due to reduction in use of fertilizers
- Generation of environmental services e.g. adoption of agro-forestry can result in provision of wood products for multiple services
- Soil carbon sequestration ó climate change mitigation
- Reduction in land land-use convention e.g. from forest to agriculture; hence maintenance **of vegetative cover**

Most of the benefits associated with the transfer and adoption of the technology on the broader scale are mainly intangible but very important for sustainable development. At the farmer level however, net benefits are tangible in terms of reductions in investments in organic nutrient sources and in yield increases over time.

2.3.2 Identification of barriers for Integrated Nutrient Management

The identified barriers for the technology were analysed using the problem tree. These are presented under E in Annex I. All barriers were identified and analysed based on stakeholder consultations and the experts own knowledge. The starter problem for this technology was inadequate nutrient for crop growth resulting in low productivity and production, low household food security, low income and persistent poverty. Additionally the problem results in nutrient mining resulting soil degradation and its attendant low productivity and production.

2.3.2.1 Economic and financial barriers

The financial barriers to the promotion and diffusion of this technology are directly linked to the cost of chemical fertilizers, which is a direct result of pricing mechanism of the product. The pricing mechanism is due to government policy of privatization and high cost of credit. Currently, interest rates of most commercial banks in Ghana range from between 25 and 30 per cent despite the fact that the country has been running single digit inflation rates for more than 24 months (November 2009 to October 2012). Others include low incomes of farmers which is as a result of low prices for agriculture produce because of absence of a sustainable pricing mechanism for agriculture produce due to the absence of policy on pricing of agriculture commodities.

2.3.2.2 Non-financial barriers to promotion and diffusion of Integrated Nutrient Management

The institutional barriers were mainly linked to limited availability of technical information and low access to extension service to end users of the technology. Integrated Nutrient Management needs information on the specific nutrients or fertilisers that have to be adopted and in what application regimes are appropriate for particular soil conditions. Such information needs to be packaged appropriately for the farmers. Closely linked to these are the inadequacy of the current structure for extension service provision and the low ratio of extension staff to farmers. These are also as a result of government policy related to employment in the public sector.

Inadequate knowledge of farmers with regards to appropriate use of various sources of plant nutrients was identified as a main barrier. Ploughing the remains of leguminous plants such as cowpeas and groundnuts into the soil rather than burning them, is an example of good use

of plant nutrient to enrich the soil. However, many farmers are unaware of the potential of plants as sources of fertilizer. This is a result of limited information from the extension service that also is limited in terms of technical capacities brought about by inadequate support from research because of weak research extension linkages.

Socio ó culturally, the main barrier is misconceptions about the technology due to low awareness about its potential brought by inadequate extension support as a result of low staff numbers. Additionally, non-availability of diversified nutrient sources could be a barrier brought about by weak linkages within existing farming systems.

2.3.3 Identified measures

Measures for improving the promotion and diffusion of were identified through stakeholder consultation and fine-tuned by the expert using own knowledge based on local experience. The measures were initially identified for each category of barriers and regrouped into economic and financial; and non-financial measures.

2.3.3.1 Economic and financial measures

Review of government policy on pricing of commodities (both local and imported) was singled out as a basic necessity for reducing the cost of chemical fertilizers and improving incomes from agriculture produce. The need for improving rural infrastructure (road, storage facilities etc.) was also identified as necessary for reducing overhead costs that are pushed to the last consumer and enable farmers hold on to produce to enable them improve their earnings.

2.3.3.2 Non financial measures

Awareness creation and training of farmers using multiple communication tools and approaches were identified as the leading measures under the non-financial measures. It goes to emphasize the point that knowledge and information flow to farmers are the critical measures for improving on their farming activities.

Review of the national policies with regards to extension service structure and staffing was also identified as necessary to enhancing service delivery to rural communities and farmers. The existing policy on the extension service limits the reach of the service to farmers in the remote areas. It is therefore important to review the policies to ensure that there is an

increase in staffing levels at the districts such that farmers in the villages would benefit from extension services effectively.

Improvement in research and extension linkages to enable flow of relevant technical information from research to extension was also identified as an important measure. Existing linkages between the agricultural research organizations and the extension system in Ghana particularly the Ministry of Food and Agriculture (MoFA) is fairly strong. However, these linkages will have to be strengthened to enhance the adoption of agricultural technologies in general by farmers

2.4 Barrier analysis and possible enabling measures for Community Based Extension Agents (CBEA)

2.4.1 Description of Community Based Extension Agents

The Community Based Extension Agents (CBEA) is a rural agricultural extension model is based on the idea of providing specialised and intensive technical training to identified people in rural communities to promote a variety of technologies and offer technical services with support and review from an extension organization. The CBEA is a demand driven model; in that provide opportunity for farmers or groups or community to contact the service provider for specific information and related services. The community based extension model can contribute to climate change adaptation through the training of service providers in climate data collection; analysis and dissemination within their areas of operation to enable communities select appropriate response strategies.

The community based rural agricultural extension model was introduced in Ghana to complement the efforts of veterinary services in addressing livestock health problems in the absence of adequate qualified staff. The practice has since been expanded to include other technical areas including crop agronomy. CARE International, an NGO, is also using it to promote climate change adaptation in parts of the northern region. The use of the model however remains on pilot basis with limited coverage.

Community Based Extension contributes to climate change adaptation by building capacity at local level for addressing local climate change problems. Community Based Extension

provides opportunity for increasing access of farmers to basic extension services including climate information and skills development.

2.4.1.1 Costs and Benefits associated with Community Based Extension

Potential sources of cost associated with transfer and adoption of Community Based Extension are as follows:

- Development of CBE programme including structure
- Development and implementation of a comprehensive awareness creation programme
- Identification and training of potential CBE agents
- Provision of tools and equipment to support work of agents
- Supervision and technical support by main extension organization
- Remuneration for CBE agents

Potential benefits of transfer and adoption of Community Based Extension

- Reduction in farmer to extension agent ratio from over 3000 farmers per one agent to 1000 farmers to one agent in operational areas
- Availability of facilitation and technical capacity within rural communities to support development activities
- Increased access to extension service including information and skills training to farmers
- Improved operation of productive activities
- Potential for sustainable increases in productivity and production
- Increases in adaptation capability and reduction of vulnerability in rural/farming communities
- Reduction in cost of extension service provision (budgetary allocation to extension service)

Whilst the initial costs for transferring the technology could be high, the medium to long-term benefits could be substantial to both end-users and Government of Ghana.

2.4.2 Identification of barriers to promotion and diffusion of Community Based Extension Agents

2.4.2 Identification of barriers to promotion and diffusion of Community Based Extension Agents

The identification and analysis of barriers for the technology were done using the problem tree. These are presented under F in Annex I. The process involved stakeholder consultations and experts knowledge and experience within the sector. The starter problem for this technology was inadequate extension service to farmers resulting in non-application of improved practices in their production systems. The direct result of these is low productivity and/or production resulting in household food insecurity, poverty and general low standards of living in rural communities. Additionally, use of inappropriate production practices is resulting in poor management of natural resources that is resulting wide spread degradation (land, forest rivers and biodiversity) thus reduction in ecosystem system resilience which further exposes communities to disasters associated with extreme climate events.

2.4.2.1 Economic and financial barriers

The economic and financial barrier to the smooth promotion and diffusion of this technology revolves around lack of motivation for available personnel because of absence or inadequacy of financial benefits for the job the agents do within their communities and absence of tools and equipment to enable them perform their duties satisfactorily. Closely associated with the above is inadequate training for the agents. The above are as a result of lack of budgetary allocation to support CBEA because it is not identified as an integral part of the national extension structure as a result of the existing national agriculture extension policy.

2.4.2.2 Non-economic and financial barriers

The main barrier is the absence of trained personnel as a result of lack of qualified persons to be trained, which is a direct result of poor quality of educational within rural communities. Rural-urban migration is also identified as a cause of non-availability of required personnel for training.

Non-appreciation of role of community based extension agents by farmers (expected users of the service) is a major barrier because of poor perception among community members due to low awareness about the importance of CBEA among rural communities which is also due to high dependence on regular extension service (free) from national extension organization.

Institutionally, limited support from the national extension service was also indentified as a barrier. This is as a result of lack of budgetary allocation because CBEA is not an integral part of the national extension service delivery mechanism.

2.4.3 Measures to address barriers to promotion and diffusion to CBEA

Measures for improving the promotion and diffusion of were identified through stakeholder consultation and fine-tuned by expert using own knowledge based on local experience. The measures were initially identified for each category of barriers and regrouped into economic and financial; and non-financial measures.

2.4.3.1 Economic and financial measures

Central to addressing economic and financial barriers is the need to review current extension system to enable integration of CBEA into the national extension structure to enable budgetary allocation to support its implementation. Additional to this could be a mechanism for engaging with not-for-profit organisations (NGOs, Relief Agencies, Faith-based Organizations, Farmer-based Organizations, etc.) to support the role out of the technology specific locations in collaboration with the local/district administration structure. There is the need to provide necessary tools and equipment and establish a clear modality for providing remuneration to trained personnel. Additionally, resources including training facilities should be provided for continuous training of personnel.

2.4.3.2 Non-economic and financial measures

There is the need to undertake sustained awareness creation on the benefits of CBEA among rural communities to remove misconceptions and encouragement of non-formal education among the adult population.

There is the need to review current extension structure and delivery mechanisms to include CBEA to enable its recognition and prioritization as major step towards addressing the wide gap between farmers and available extension staff.

The national extension service should develop a comprehensive action plan for rolling out and supporting CBE in rural communities complete with training actions.

2.5 Barrier analysis and possible enabling measures for Water Users' Association

2.5.1 Description of Water Users' Association

A Water User Association (WUA) is a unit of individuals that have formally and voluntarily associated for the purposes of cooperatively sharing, managing and conserving a common water resource. The objective of a WUA include; conservation of water catchments; sustainable water resource management; increase availability of water resources; increased usage of water for economic and social improvements and development of sustainable and responsive institutions. The WUA can contribute to climate change adaptation by providing a cooperative mechanism through which impacts of climate change on water resources can be monitored and water users and decision makers can be empowered to manage and allocate water resources with a consideration for climate change.

The concept of Water User Associations was introduced in Ghana as major step towards involving farmers at irrigation facilities in the management of schemes and allocation of water rights. This is necessary for effective and efficient management and maintenance of the schemes in collaboration with government organizations. Since its introduction the concept have been found to be workable and has led to improvements in management of irrigation facilities especially small-scale schemes.

Water Users Association as a soft technology for the management of water resources for multiple uses has the potential for contributing to climate change adaptation especially in water stressed communities. The WUA provides for sustainable management of water resources whilst ensuring equity in allocation of water rights. Under climate change conditions, it is important to ensure all-year availability of water for multiple uses. A well functioning WUA can contribute greatly not only to the management of natural water

resources but also put in place plans and programmes for harvesting and storing rainfall for future usage.

Water Users Associations has the potential for contributing immensely to improved agricultural productivity and income earning opportunities through ensuring more reliable supplies and equitable distribution of water.

2.5.1.1 Costs and benefits associated with transfer of Water Users Association

Sources of potential costs associated with transfer and diffusion of WUA are as follows:

- Establishment of WUA structure
- Training of management of WUA
- Administrative cost
- Awareness Creation for membership mobilization
- Institutional support from public organization

Potential benefits associated with WUA are as follows:

- Increased availability of water for multiple uses
- Saving of time from water collection for other activities
- Decreased incidence of water borne diseases
- Increased production (all-year) of crops and livestock
- Improved household food security
- Improved household income
- Improved management and sustainability of water resources
- Absence or reduction in water related conflicts

Most of the benefits associated with the technology are intangible goods and therefore cannot be quantified in fiscal terms. A qualitative assessment of the potential costs and benefits of the WUA indicates that in spite of possible high costs associated with initial activities for its transfer, the technology has the potential for providing multiple benefits that cuts across social, economic and environmental services in addition to building institutional capacity for

planning, implementation, monitoring and evaluation of other community level resource management activities.

2.5.2 Identification of barriers to the promotion and diffusion of Water Users' Association

The identification and analysis of barriers for the technology were done using the problem tree. These are presented under G in Annex I. The process involved stakeholder consultations and experts knowledge and experience within the sector. The starter problem for this technology was ineffective management of water for multiple uses. The direct result of these is the unavailability of water for productive purposes (crop production, animal watering etc) and potable water for domestic uses. The situation results in low production, resulting in household food insecurity and incomes. Additionally, the situation results in the use of poor quality water for domestic purposes that results in prevalence of water borne diseases e.g. diarrhoea, guinea worm etc.; general poor health of the rural population especially children. The situation leads to poor attendance of children in schools whilst the adult population are unable to undertake productive work resulting in low production, low food security and general low standard of living within rural communities

2.5.2.1 Economic and financial barriers

The main economic and financial barrier is absence of facilities and equipment brought by either absence of or inadequate funding of the activities of the Water User Associations. The inadequate funding of Water Users Associations is brought about first by weak institutional support because they are not an integral part of the national structures for the management of water resources hence have no budgetary allocations, which is a result of existing policies. Secondly, expected contributions from members of the associations might not be regular because of the low incomes of the members which could be a result of low productivity of members' productions as a result of production constraints, poor management practices and/or poor prices for their commodities as a result of poor marketing policies.

2.5.2.2 Non-financial barriers

Under non-financial barriers the major issue is the ineffective management of the WUAs, which is a result first of inadequate technical and management skills of the leadership brought about by inadequate institutional support and training.

Secondly, there is no guiding legal framework because existing policies do not provide for WUAs. Thirdly another barrier is inappropriate composition of the WUA brought about by lack of clear criteria for composition of leadership.

Additionally, poor human relation is a major barrier to the smooth functioning of WUAs. This could be a result of negative attitudes of some members, brought about by misconception of the objectives of WUAs due to low awareness of the objectives and functions of WUAs.

2.5.3 Identification of measures to address barriers to promotion of Water Users' Association

2.5.3.1 Economic and financial measures

The main measure identified to address the economic and financial barriers is the need to review the existing water policy to provide for inclusion of Water Users Association within the water management structure. This will enable institutional support through budget allocations for training for and administrative management by the WUAs. To secure regular and adequate contributions of members of the WUAs, the need to put in place a pricing mechanism for agricultural produce to enable enhancement of incomes of farmers. Closely associated to improving incomes of farmers is the need to train and provide appropriate extension services to enable farmers improve their productivity and production that together with an efficient pricing mechanism will enhance farmers' incomes sustainably.

2.5.3.2 Non-financial measures

As for the non-economic and financial measures the need to review the current water policy to provide for Water Users Associations in the management of water resources. This will provide for the establishment of clear procedures for the establishment and management (including selection of leaders) of WUAs.

The need for development of and implementation of sustained awareness creation programme was identified as a vehicle for clarifying the objectives and functions of WUA, to help clear misconceptions about role of WUAs in the management of water resources and therefore address the issue of negative attitudes towards the role WUAs.

Technically, there is the need for development of a mechanisms and training curriculum for the development and strengthening of WUAs to effectively contribute to management of water resources.

2.6 Barrier analysis and possible enabling measures for Ecological Pest Management

2.6.1 Description of Ecological Pest Management

Ecological Pest Management (EPM) also referred to, as Integrated Pest Management (IPM) is an approach that aims at reinforcing the natural processes of pest regulation and improved agricultural production. The practice encompasses the use of multiple strategies in a compatible manner to maintain pest populations at levels below economic injury levels while providing protection against hazards to humans, animals, plants, and the general environment, thereby contributing maintenance of agro-ecological biodiversity. EPM (IPM) lays heavy emphasis on the growth of healthy crop with little disruption of agro-ecosystems. Chemical pesticides can only be used when the natural strategies and methods fail to keep pest below expected damaging levels.

There are three (3) major components of EPM as follows:

- Crop management ó selection of appropriate crop for local climate and soils conditions
- Soil management ó maintenance of soil nutrition and pH levels to provide the best possible soil environment for crop growth and development
- Pest management ó use of beneficial organisms that act as parasitoid and predators to regulate pest populations

The practices if well implemented results in systems that are:

- Self ó regulating (maintenance of pest populations within acceptable limits)
- Self ó sufficient (minimal use of reactive interventions)

- Increased resistance to stresses such as drought, soil compaction, pest invasions, etc.
- Ease of possible recuperation from stress

Ecological Pest Management is one of a 'clean technology' that combines life cycle of crops, insects and associated fungi with natural external inputs to guarantee good harvests even under conditions associated with climate change. The contribution of EPM to climate change adaptation is linked to its support for maintenance of ecological integrity including decrease in the vulnerability of plants to pest and diseases. Ecological Pest Management practices include good soil and water management practices, which are major climate change adaptation practices.

In addition, selection of crops varieties and breeds of livestock that are compatible with local conditions is essential for ensuring food security under climate stress conditions. Ecological Pest Management as a crop management technology also supports diversification of farming system hence helps farmers build resilience to potential risks associated with changing climatic conditions and effects

2.6.1.1 Cost and benefits associated with transfer and diffusion of Ecological Pest Management

Sources of potential costs associated with Ecological Pest Management

- Development and packaging of EPM protocols
- Training of subject matter specialists/extension supervisors
- Training of frontline extension agents
- Development and dissemination of extension materials
- Establishment of demonstrations
- Education and training of farmers

Potential benefits to be derived from adoption of EPM are as follows:

- Sustained increased yields, due to improved soil conditions
- Reduction in farmers' use of pesticide of between 30 and 70 per cent

- Ecological balance of fauna and flora
- Low or total absence of food contamination from chemicals ó reduced health risks
- Conservation of crop varieties and animal breeds that are adapted to local conditions

Potential benefits from EPM are largely intangible but far out weigh costs. At the farmer level, net benefits that accrue from reduced cost of production and increased yields can be substantial. However, a qualitative assessment of the benefits of the technology to farmers, and the larger society and the environment in the medium to long justifies the need to invest in its transfer and promotion for adoption.

2.6.2 Identification of barriers to the promotion and diffusion of Ecological Pest Management

The identification and analysis of barriers for the technology were done using the problem tree. These are presented under H in Annex I. As in the case of other technologies the process involved stakeholder expertø and consultantø knowledge and experience within the sector. The starter problem for this technology was inappropriate pest management practices. The direct result of this is diverse including pollution of water bodies, persistence in food that has direct impact on human health. Additionally, the inappropriate use of agrochemicals results in biodiversity loss through the destruction of beneficial fauna, which results in the destruction of the agro-ecosystem. The reduction of capacity of agro-ecosystems, results in low productivity, which has a direct result of low food production that affects household food security, household income hence perpetuates poverty.

2.6.2.1 Economic and financial barriers

The major economic and financial barriers are those associated with improved crop and soil management absence of which could lead to high percentage crop losses that could result. Such barriers will include high cost of soil amendments, improved seeds etc. Directly related to this is the cost of developing and multiplying relevant biological agents compared to the cost of conventional pesticides. In the short-term income losses because of absence of special pricing for biologically produced commodities

2.6.2.2 Non-financial barriers

The main barrier to the promotion of the technology is the limited knowledge of farmers about the technology brought about by the emphasis placed on the use of conventional pest management methods because of lack of information on ecological pest management tools. The lack of information is as a result of little or no research effort directed at enhancing ecological pest management options. Additionally farmers look for quick fix solutions to solve their pest problems and conventional pesticides are available at relatively cheap prices

2.6.3 Identification of measures to address barriers to the promotion and diffusion of Ecological Pest management

2.6.3.1 Economic and financial measures

The main economic and financial measures identified were the need for an enabling agriculture and fiscal policies that will make it possible for farmers to access necessary farm inputs at affordable prices. There will be the need to provide funding for research and development of relevant biological agents that will control pest populations. This combined with good agricultural management practices is expected to result in increases in productivity and production possibly lead sustainable incomes for farmers

2.6.3.2 Non-economic and financial measures

The main institutional measures identified are the need for enabling policy that allows for engagement of extension staff and adequate budgetary allocation to the service. These it is expected will enhance the effectiveness of the extension service delivery including support the development of FBOs and hence improve the flow of information to farmers.

Technically, the need to improve or strengthen the linkage between research and extension was identified as a major measure. This is expected to enhance technical support to extension staff which will lead to effective extension service delivery subsequently leading improved skills at farmer level if combined with improvement in staff numbers. The existing linkages can be achieved by enabling operations of the Research Extension Linkage Committees (RELCs) through regular funding. Currently, the RELCs are dependent on projects to run with little support from either research organizations or agriculture extension. There is the urgent need to improve the technical capacity of the extension service that would enable staff

to be able to translate research information into farmer user friendly forms with little support from the research.

From the socio-cultural perspective, enhanced extension service delivery has been identified as a major measure that is expected to undertake effective awareness creation activities on good pest management options to farmers. This combined with increased use of indigenous knowledge with emphasis on traditional best and other coping strategies will result in good management practices at farm level hence improved pest management.

2.7 Linkages of the barriers identified

The common barriers for the four identified technologies revolved around inadequacies of current policies regarding agriculture development, water management and economy (free market system). Whilst the policies on agriculture extension and water management lays heavy emphasis on the role of government in delivery of services and resource control, the economic policy lays heavy emphasis on the role of the private sector in the determination of commodity prices which turns to limit the capacity of rural communities to benefit from a free market system. Under all the technologies, technical capacities of the end-users of the technologies have been identified as a major barrier, which needs to be addressed. From the socio-cultural perspective, misconceptions of the farmers about the technologies derived from low awareness and mis-understanding of the objectives of the technologies has also featured among the barriers of all the technologies.

Specifically the following barriers stand out as important across the technologies:

- Inadequate extension service delivery as a result of high farmer to extension staff ratio which is a result of national policy on public sector employment that restricts staff engagement to only replacements.
- Weak research ó extension linkages resulting in limited capacity of extension staff.
- Inadequate community and local (district) level capacity, including technical skills resulting in low adoption of technologies
- Inadequate integration of the technologies in policy plans resulting in their poor diffusion and adoption.
- Misconception of technologies brought about by inadequate awareness creation about the potential of the technologies.

- Incoherent government policy on agriculture and climate change to drive dissemination and adoption of the technologies and create synergies.

2.8 Enabling framework for overcoming the barriers in Agriculture sector

For all technologies analysed the need for the review of current pricing mechanism of agriculture produce has been identified as a pre-requisite for ensuring farmers/rural communities increase earnings from the sale of their produce. This could be combined with improved processing and postharvest management systems that ensure farmers could hold their produce over reasonable periods.

For the Integrated Nutrient Management the need to strengthen research and extension linkages to enable effective flow of information from research through extension to farmers is necessary to address the knowledge gap at the farmer level. In the case of Community Based Extension Agents, a review of current national extension policy or strategy to cater for CBE and WUA within the national extension structure will be a major step towards improving funding to support the roll out of the technology within farming communities. This will also ensure that adequate institutional and technical support that is required for the effective operation the CBE and WUA is provided by identifiable (public and private service providers) extension organizations

The need for the review of the national water policy to cater for use of Water User Associations as part of the existing water resource management structure is key to ensuring the institutional support (technical training, tools and equipment) that is required for effective and sustainable functioning of WUAs. Communities need to be organized to self-manage their water resources. The WUAs are important vehicles for enabling the respective communities to develop their own sustainable management practices.

The following will provide broad frameworks for enabling environments for improving the promotion, diffusion and adoption of the technologies.

- Prioritization of climate change as an important development and cross-cutting issue that has implications for the sustainability of the food and agriculture sector; and subsequent development of strategies and /or mechanisms to increase productivity

whilst building resilience within the sector. This will provide opportunity for prioritizing these technologies for promotion, adoption and uptake. It should lead to increased budgetary allocation in support of the diffusion of the technologies and the facilitation of the involvement of external agencies with requisite know-how and other resources.

- Deepening of the national decentralization process to enable strengthening of decentralized departments including the extension services with well qualified staff to provide necessary technical support to field extension agents to adequately animate and train farmers to derive optimum benefits from their undertakings. Additionally, depending on their requirements, the districts could engage additional staff to boost current numbers or could establish operational MOUs with not for profit organizations to complement the government extension service delivery efforts.
- Stable macro-economy that continues to grow with a GDP rate of not less than 8 per cent with contributions from the agriculture not below current levels (27 ó 30 per cent). This will enable the continuous recognition of the importance of agriculture sector to the national development and will provide opportunity for addressing issues e.g. low extension staff numbers and inadequate budgetary allocations to the sector affecting the development of the sector. Indeed, African governments including Ghana have committed themselves to allocating not less than 10 per cent of annual budgetary allocations to agriculture. Achievement of this target could go a long way to address current issues relating to financing of the sector.

3. Conclusion

The effective analysis of barriers to the transfer and diffusion of technologies is a critical step in developing positive counter measures to the barriers. Ghana's choice of technologies dwelt heavily on technologies which touch the lives of the ordinary citizenry in the rural communities. From the rainwater collection systems on ground surfaces to the pest management technologies for the farmers, the technologies present opportunities enhancing the socio-economic activities of the people in the rural and marginalized communities. However, the identified barriers such as the low level of expertise in the deployment of these technologies, the inadequate resources for community actions on the technologies, the limited communal expertise to support the diffusion of the technologies and the lack of information on the technologies generally requires a project or programme approach to the transfer and diffusion of the technologies. These barriers are however inter-connected as some are the results of the others.

The measures thus developed to address the barriers need to be taken holistically. For example, a policy framework will need to address economic or financial concerns in the same manner that they address non-economic concerns. The prioritization of resource allocation for the promotion of these technologies including the creation of awareness and public education down to the communities will go a long way to facilitate technology adoption, transfer and diffusion. The relevant stakeholder institutions especially the Ministry of Food and Agriculture, the Ministry of Local Government and Rural Development and other policy institutions, the district assemblies and civil society organisations need to work in harmony to achieve synergy in implementing the measures.

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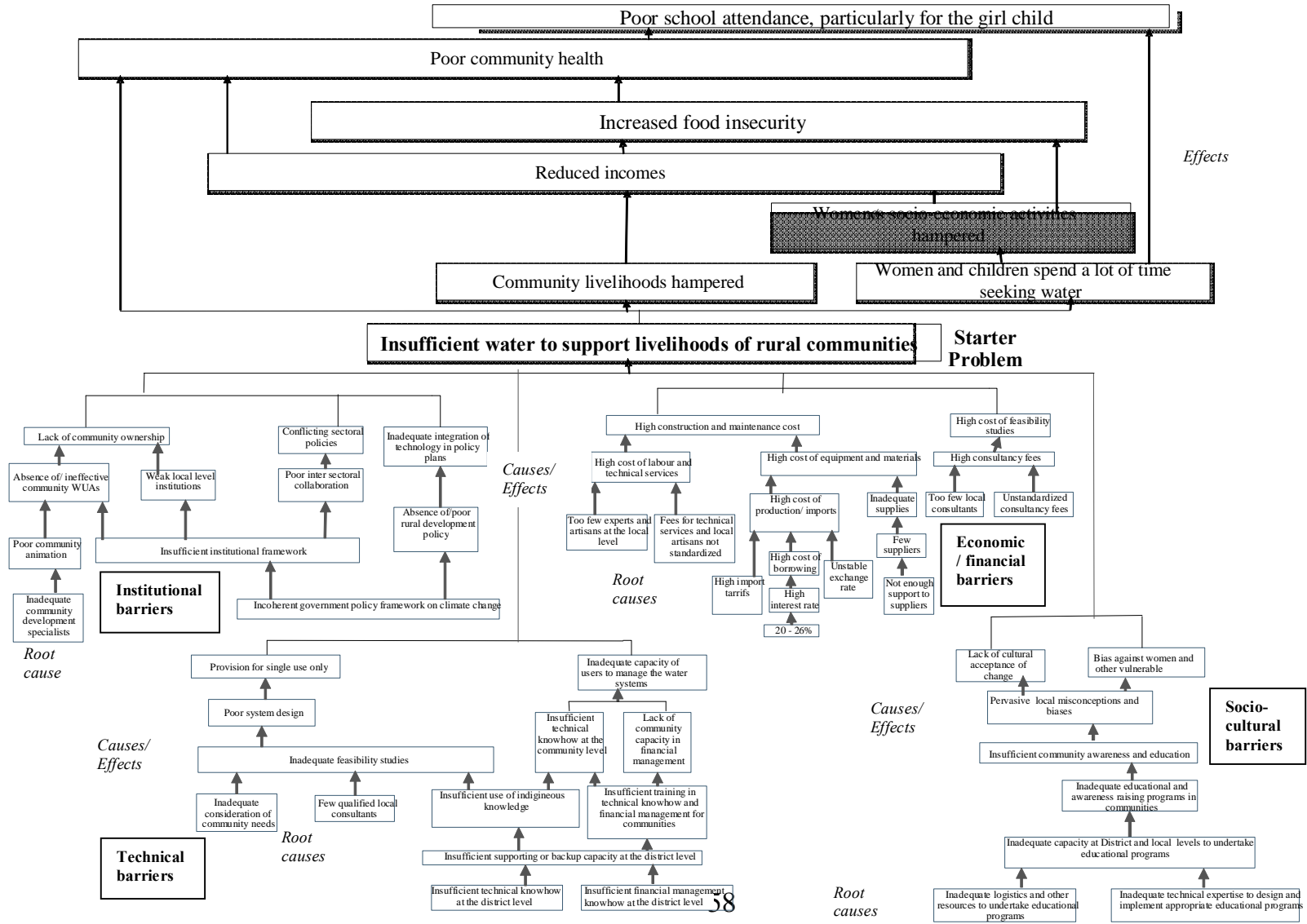
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Annex I: Problem and Measures trees

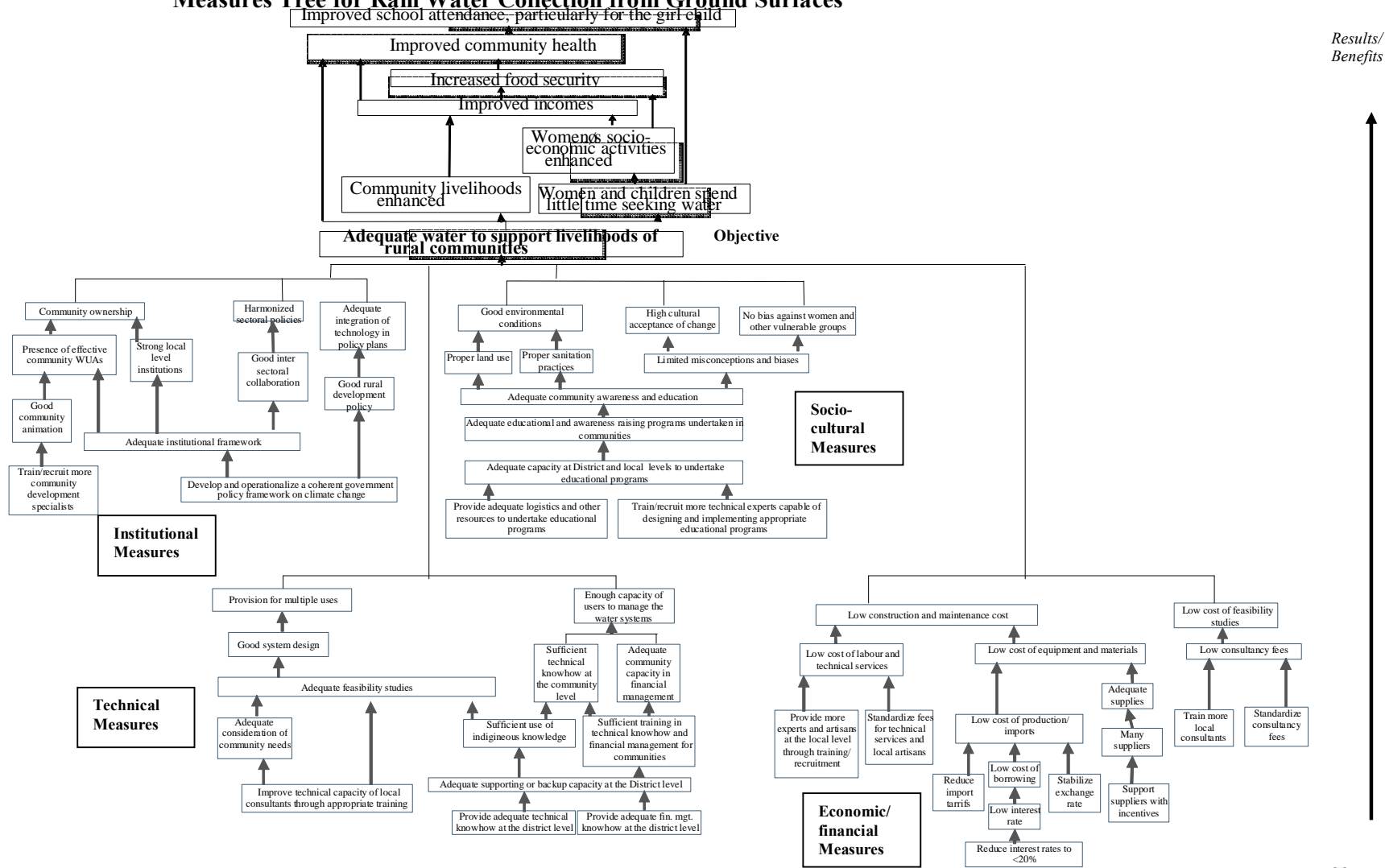
i. Water Sector

A Rain water collection from ground surfaces

Barrier Tree for Rain Water Collection from Ground Surfaces

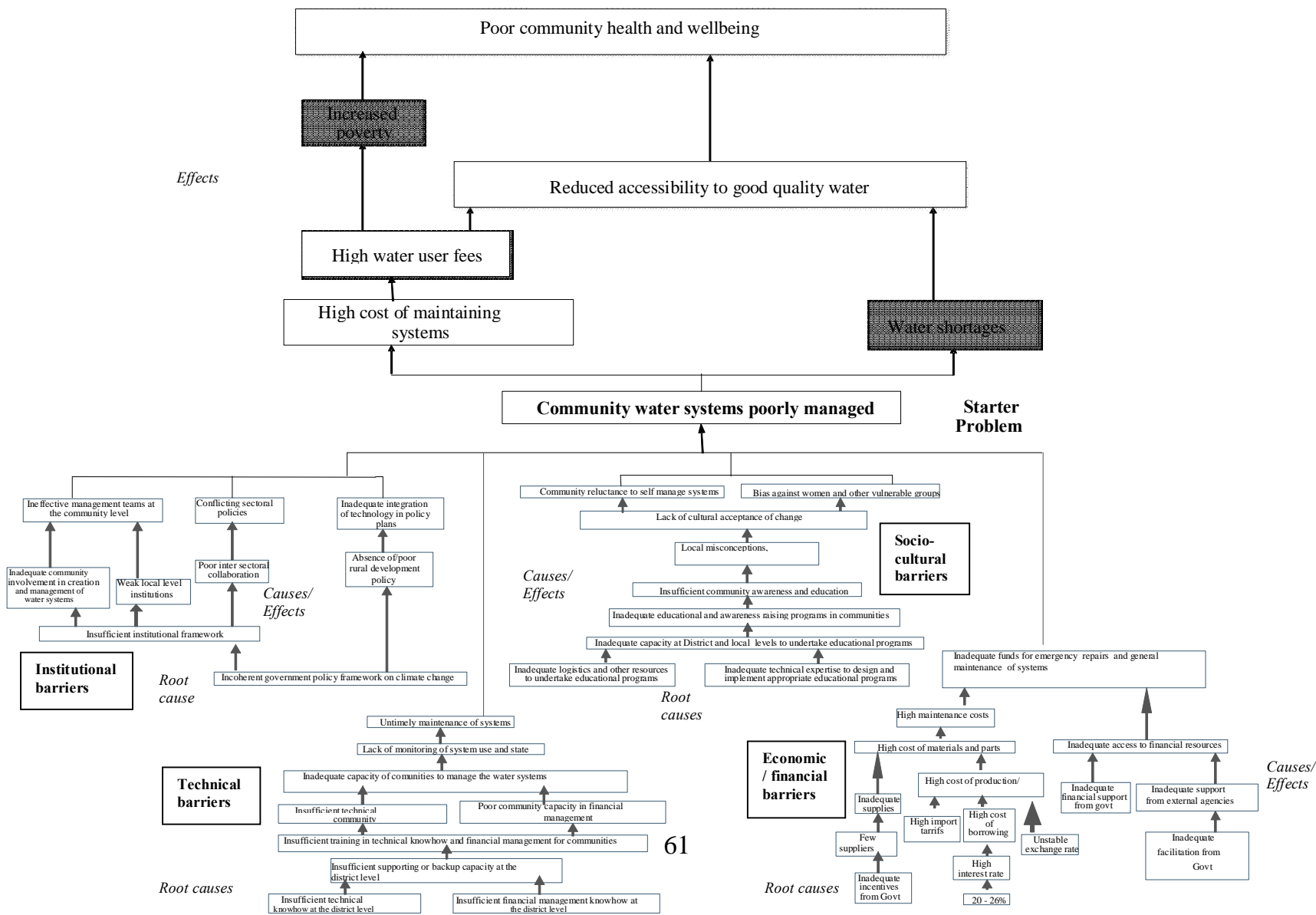


Measures Tree for Rain Water Collection from Ground Surfaces

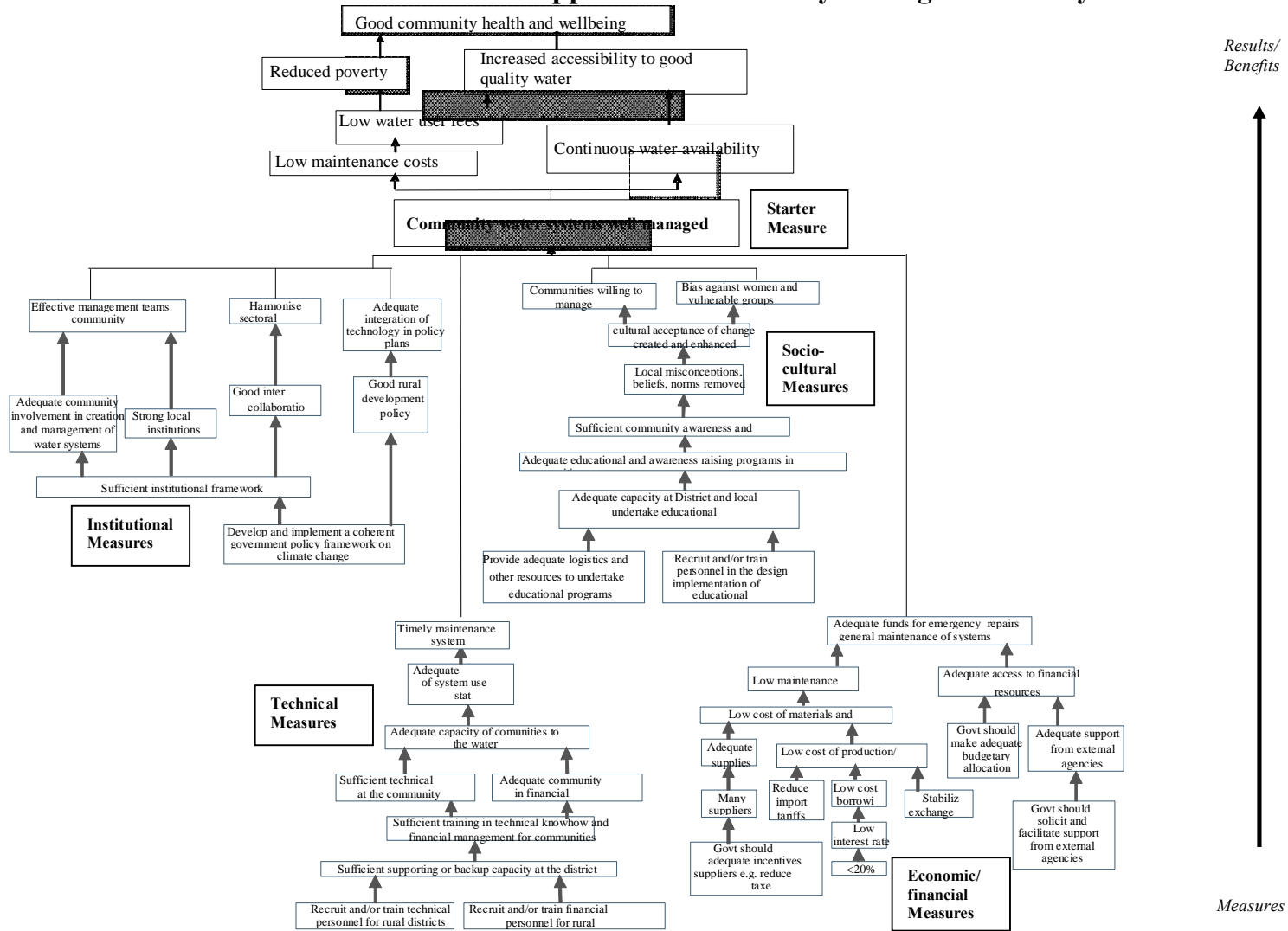


B Post-construction support (PCS) for community- managed water systems

Barrier Tree for Post Construction Support for Community Managed Water Systems

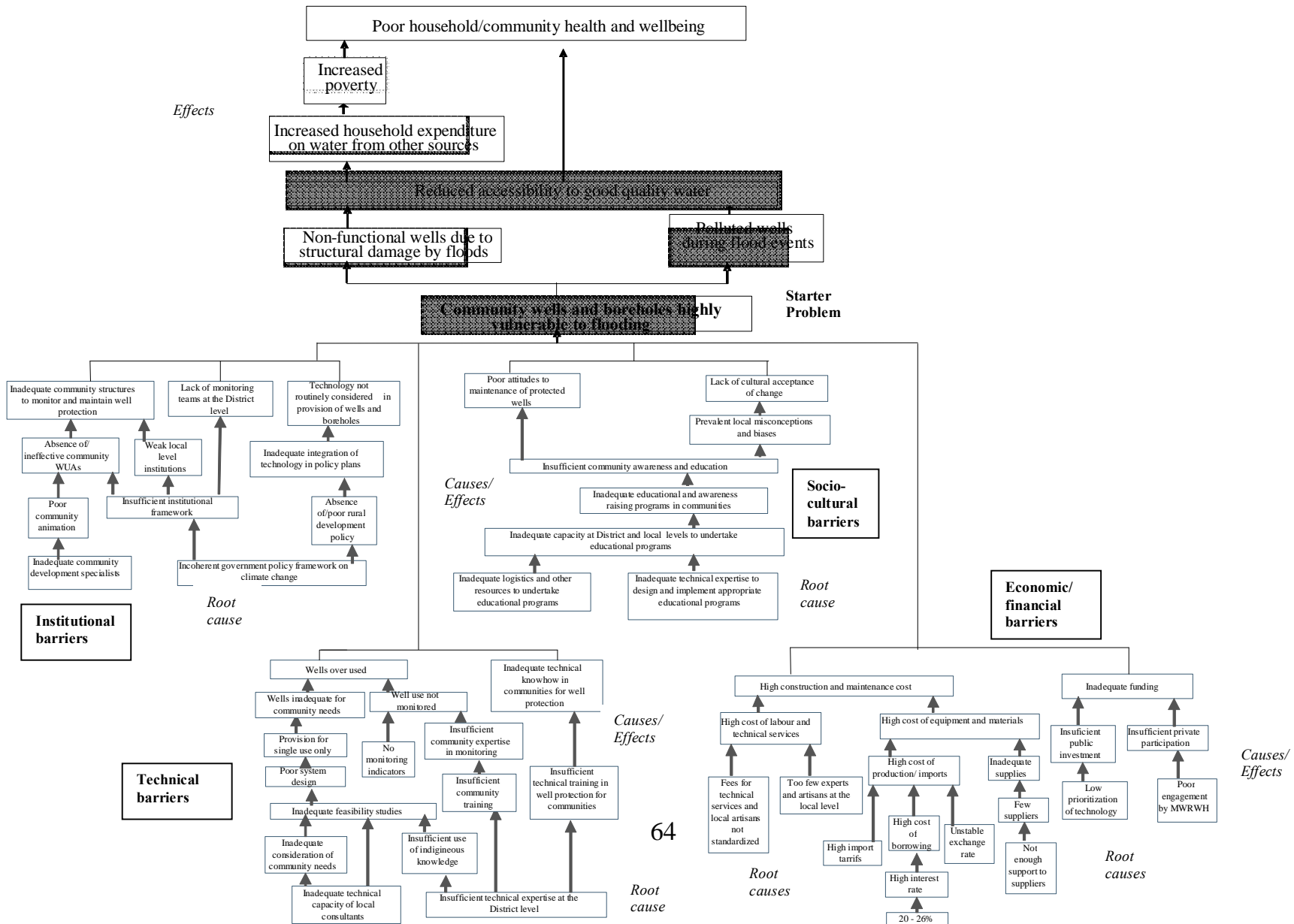


Measures Tree for Post Construction Support for Community Managed Water Systems

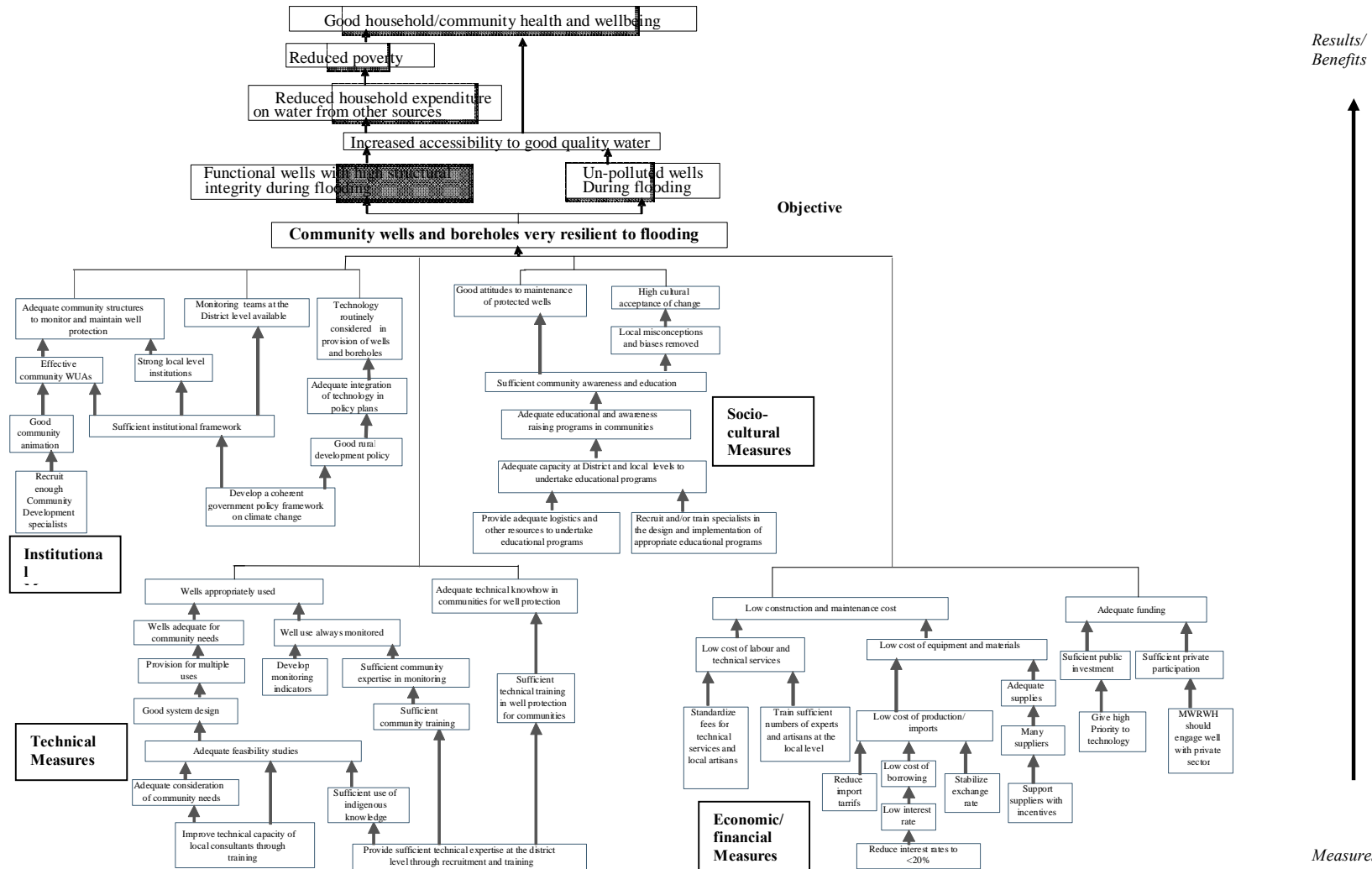


C Improving resilience of protected wells to flooding

Barrier Tree for Improving Resilience of Protected Wells to Flooding

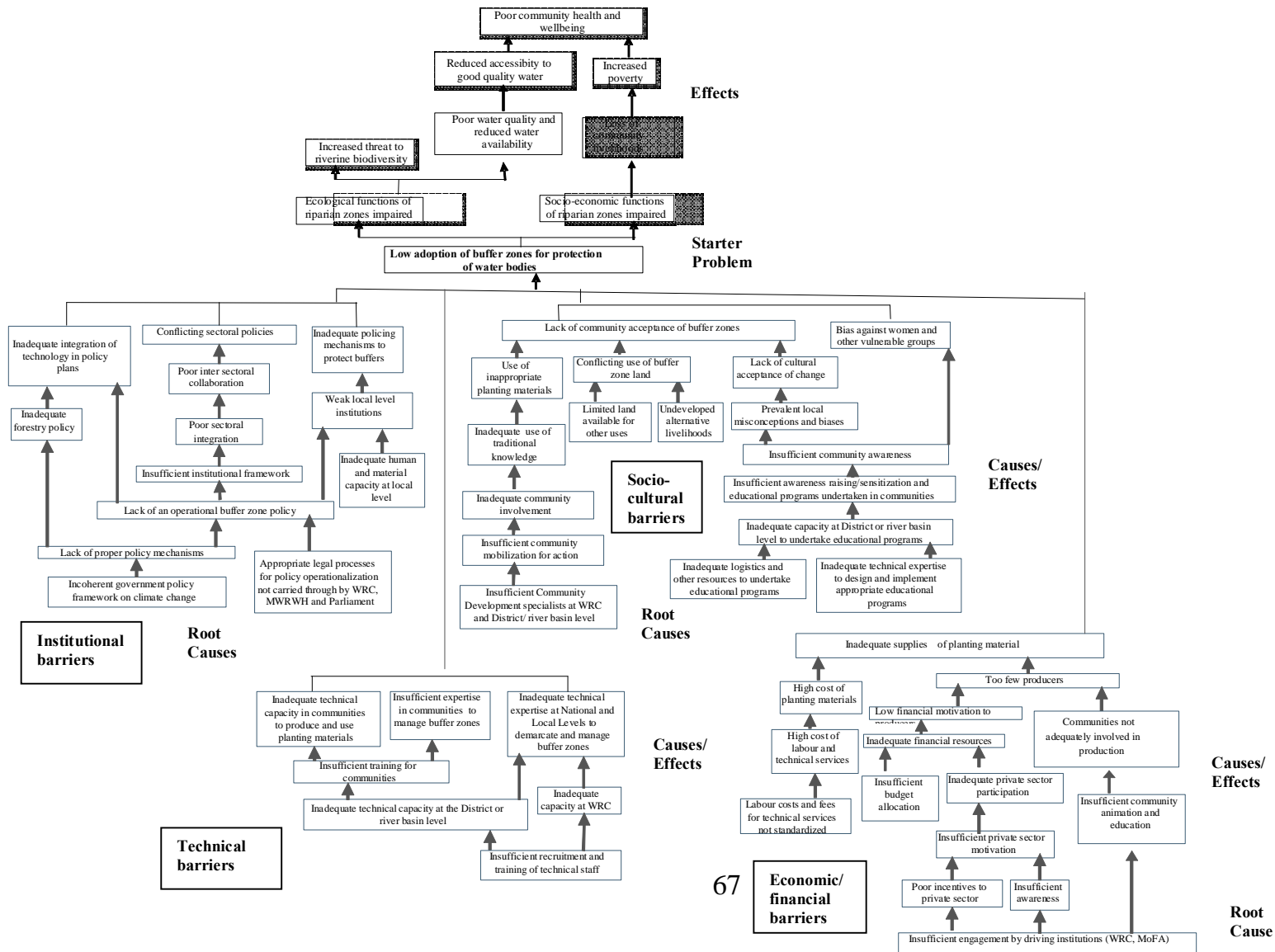


Measures Tree for Improving Resilience of Protected Wells to Flooding

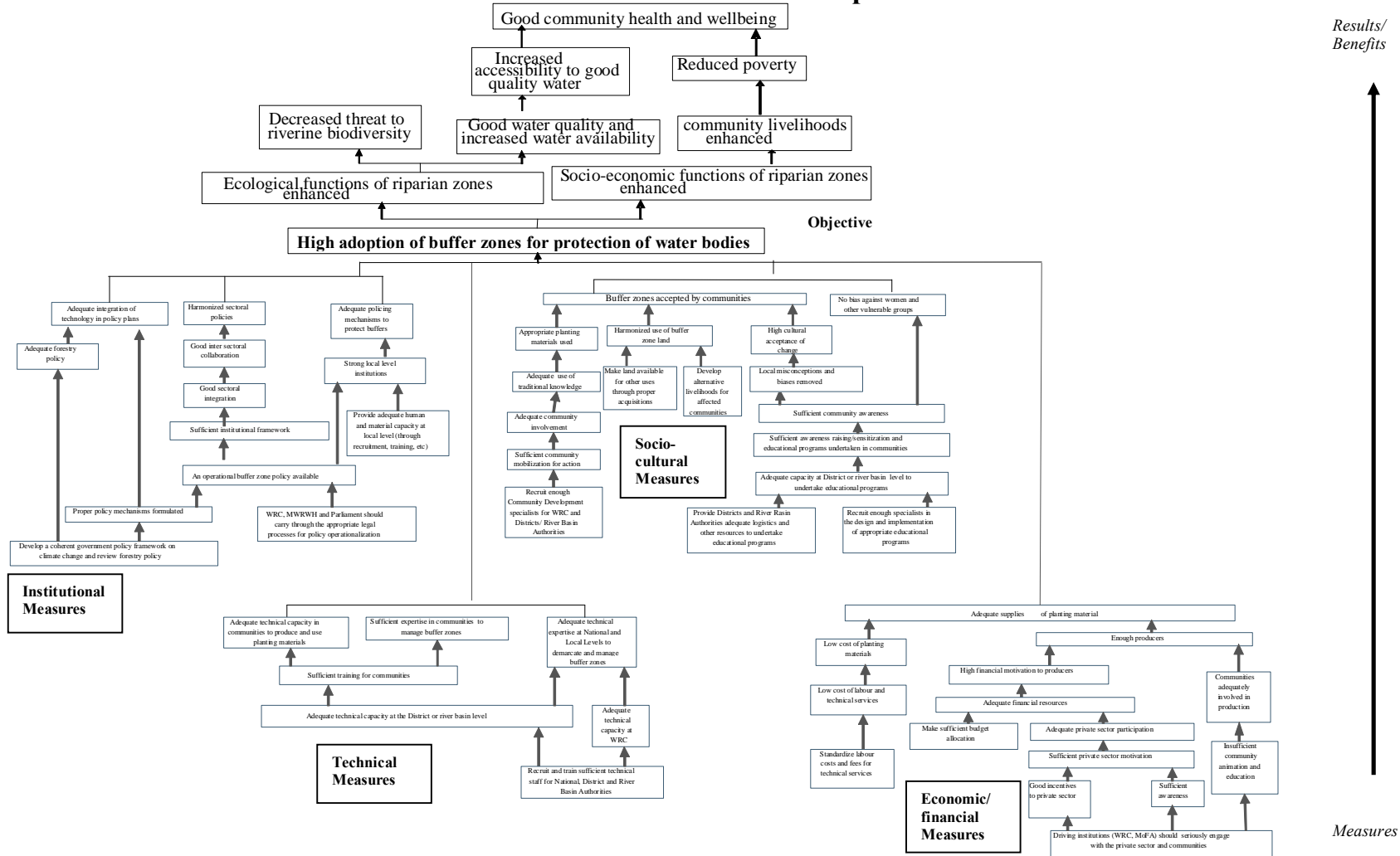


D Demarcation and Protection of Riparian Buffer Zones

Barrier Tree for Demarcation and Protection of Riparian Buffer Zones

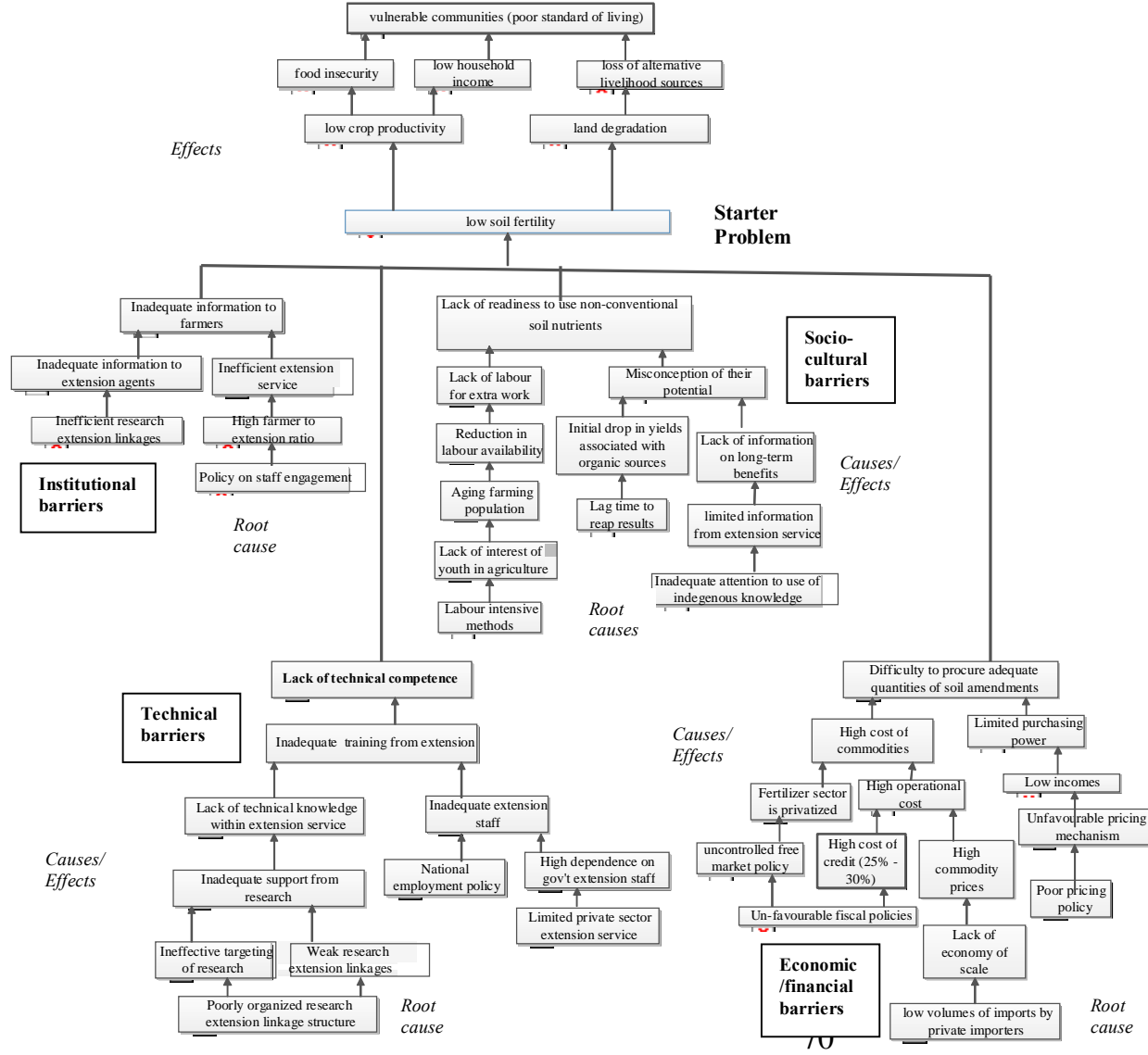


Measures Tree for Demarcation and Protection of Riparian Buffer Zones

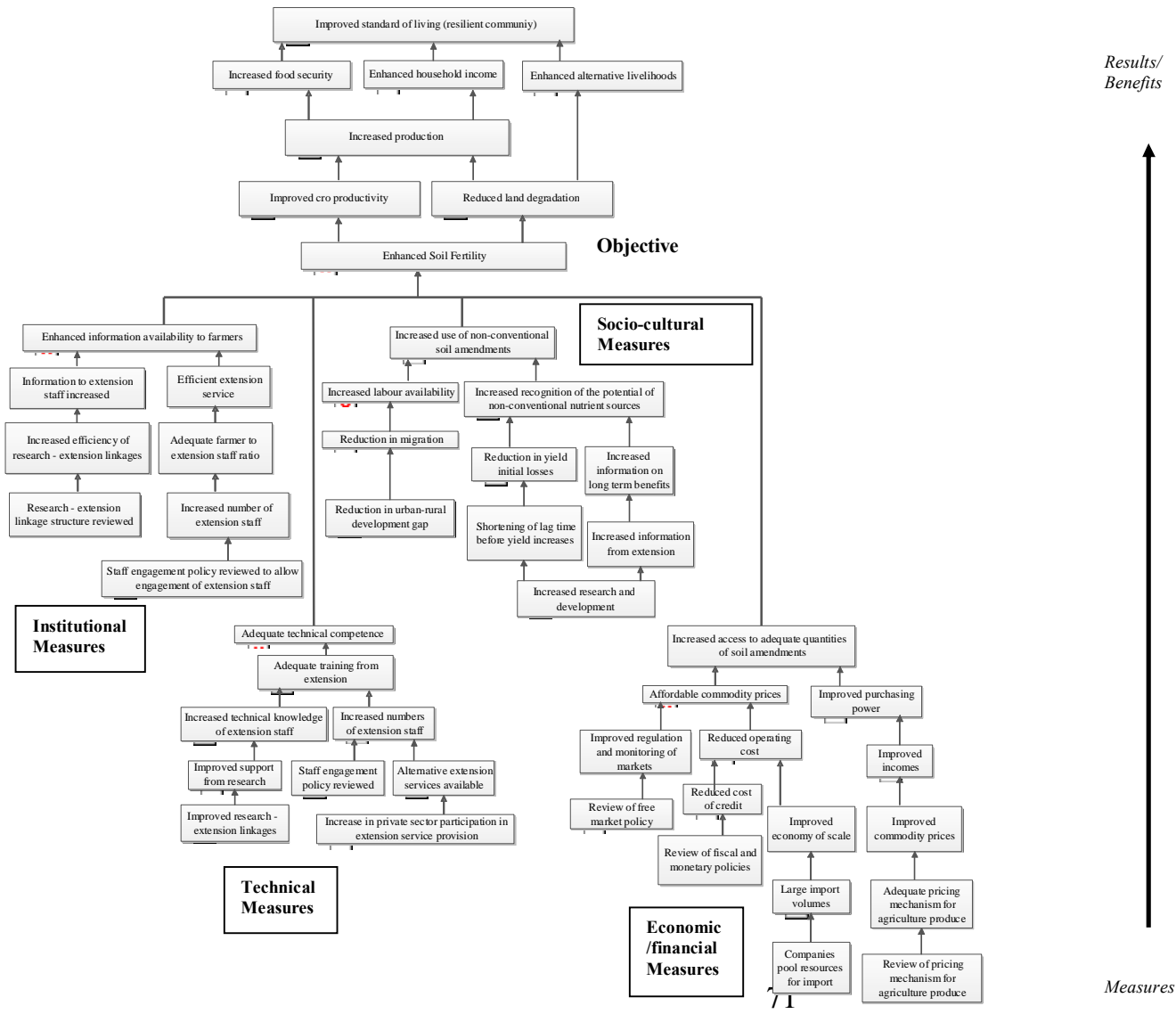


- ii. Agriculture Sector**
- E. Integrated Nutrient Management**

Barrier Tree for Integrated Nutrient Management



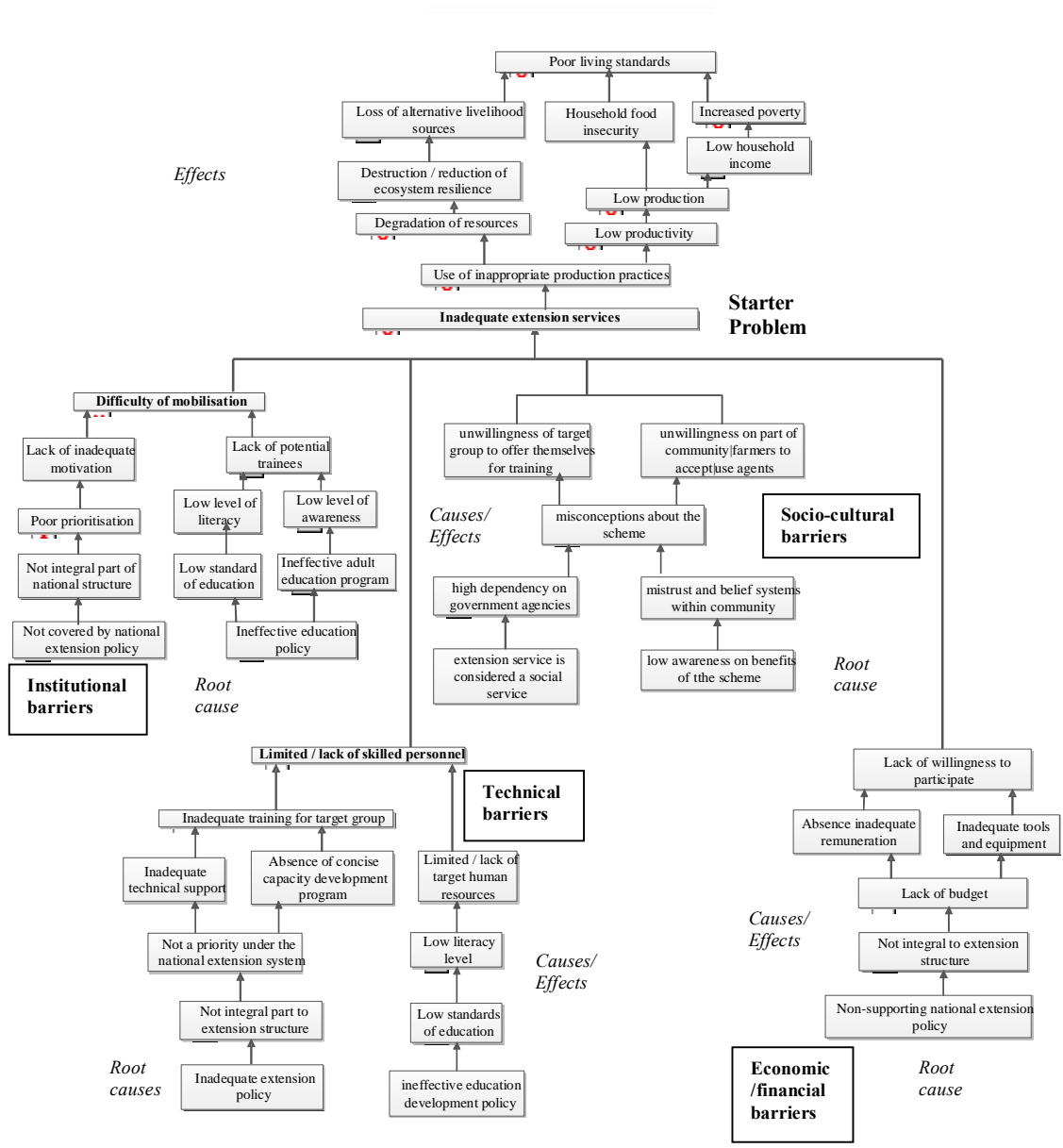
Measures Tree for Integrated Nutrient Management



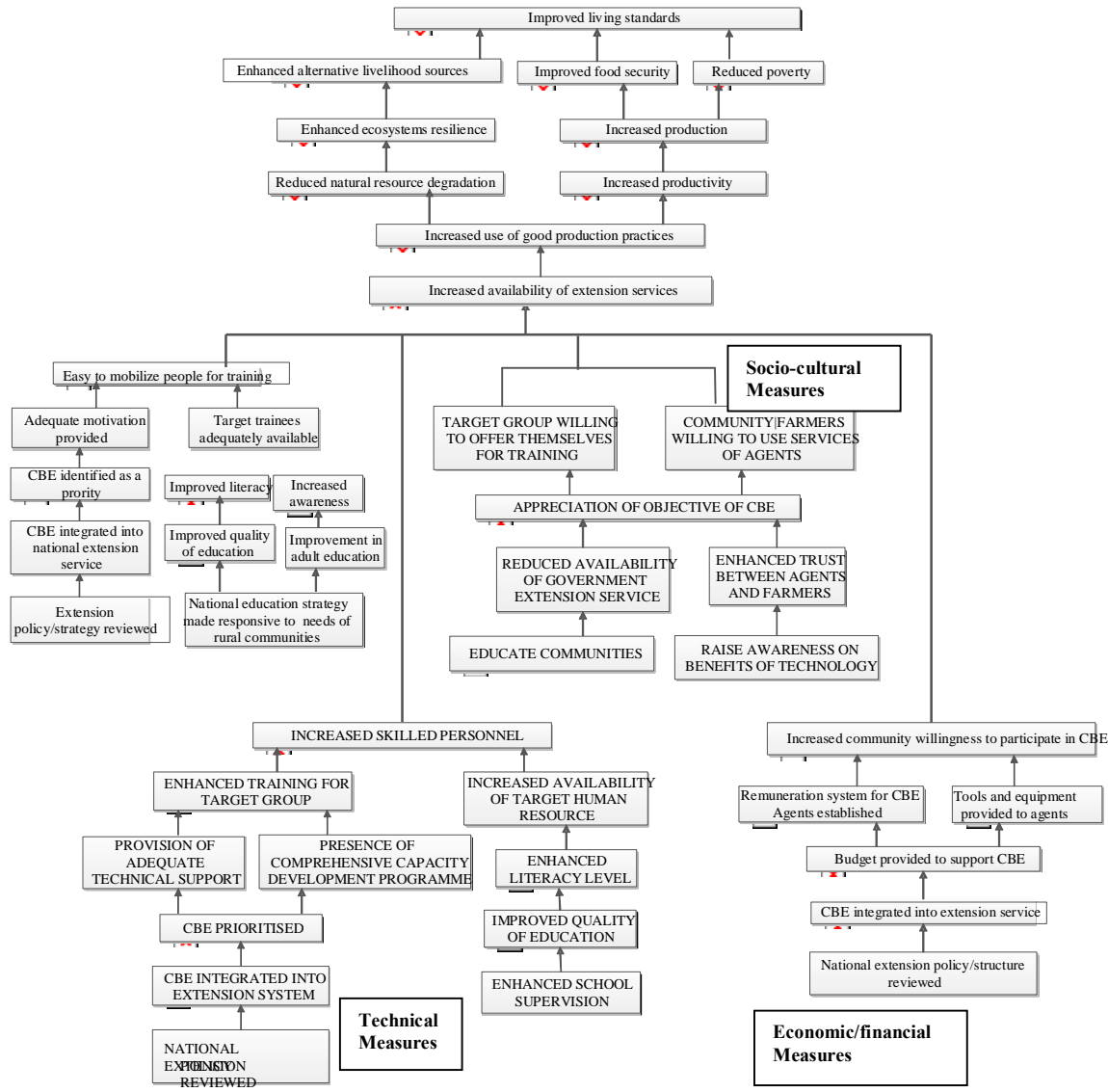
Results/
Benefits

Measures

F. Community Based Extension



Measures Tree for Community - Based Extension

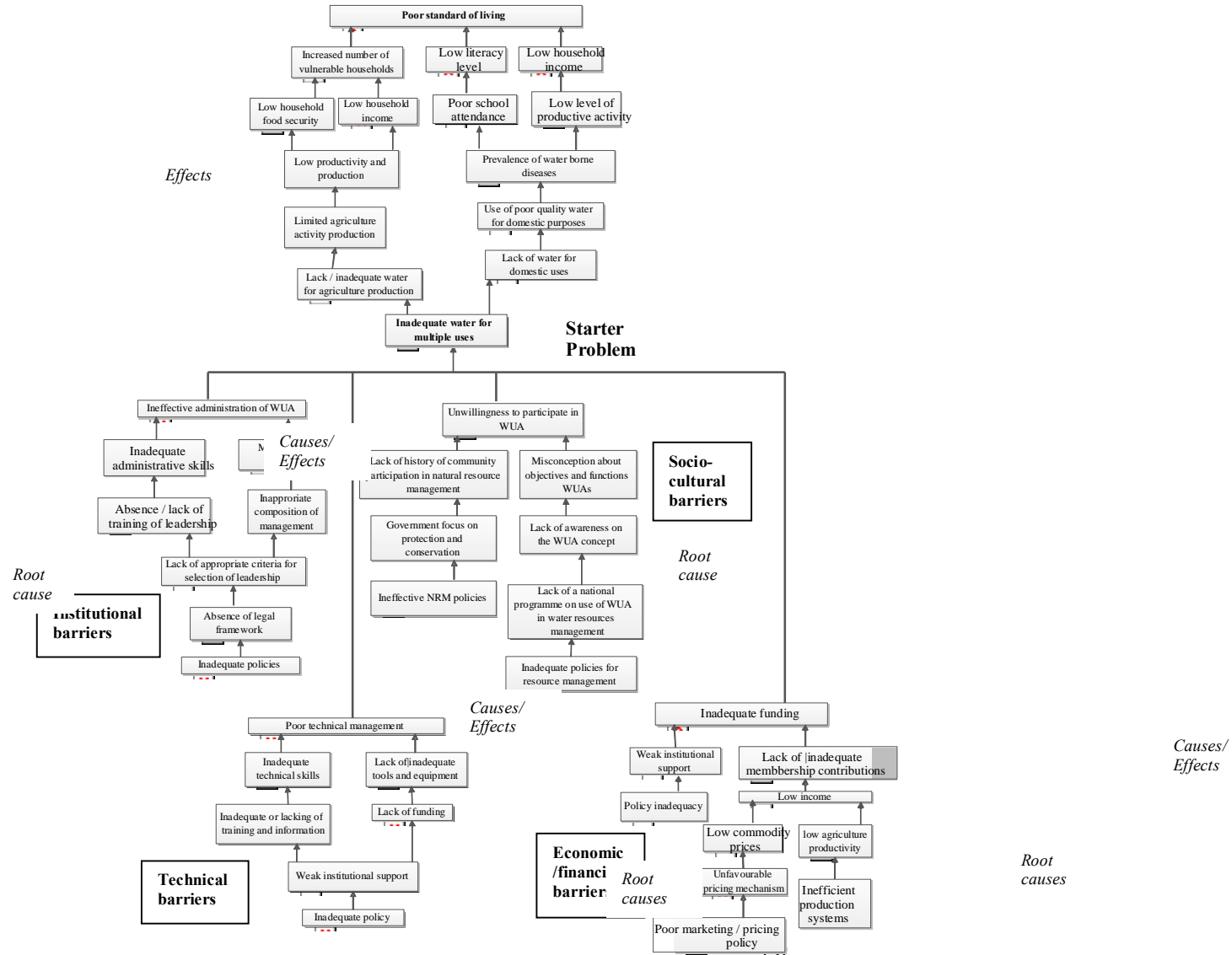


Results/
Benefits

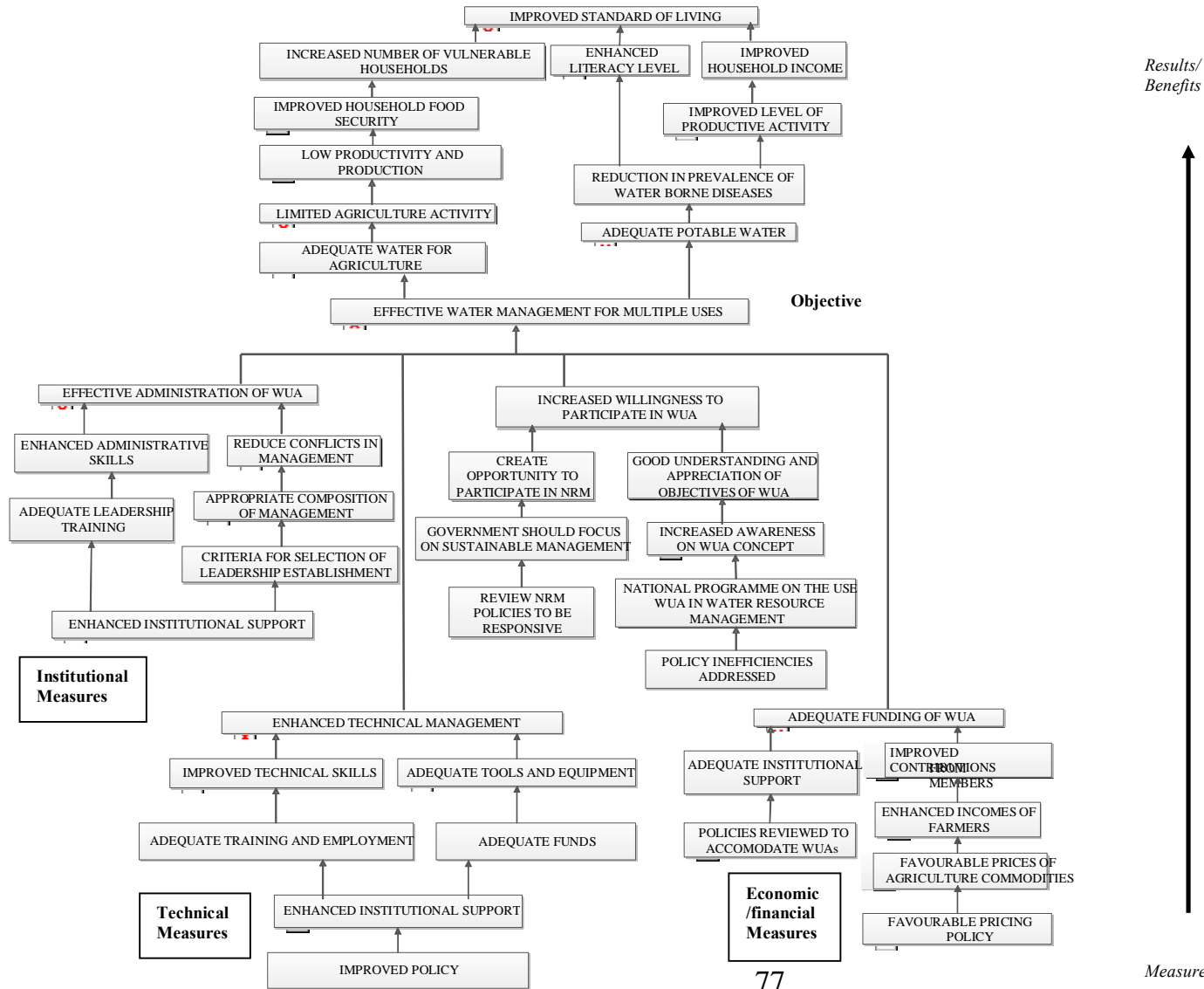
Measures

G. Water Users Association

Barrier Tree for Water Users Association

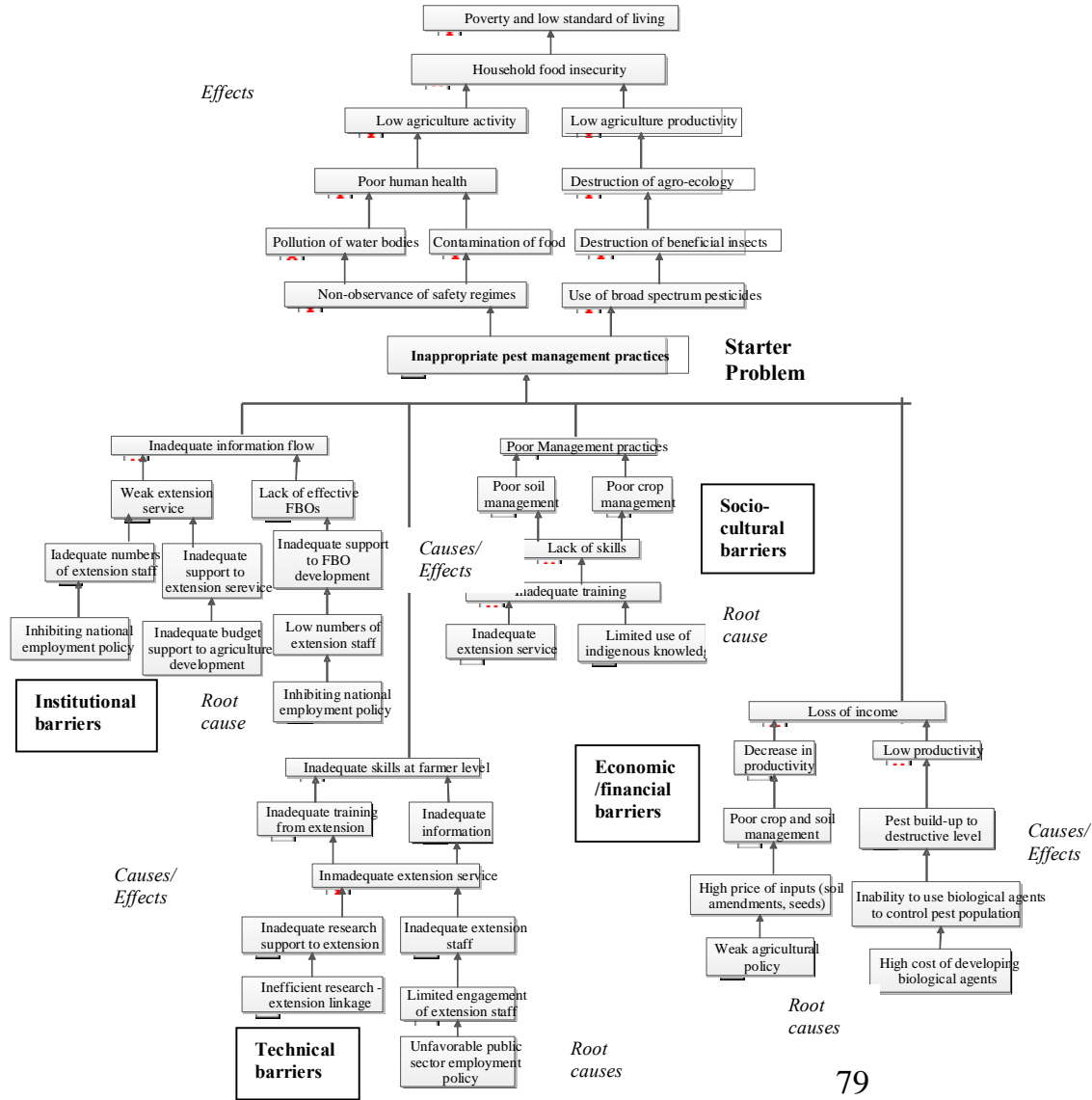


Measures Tree for Water User Association

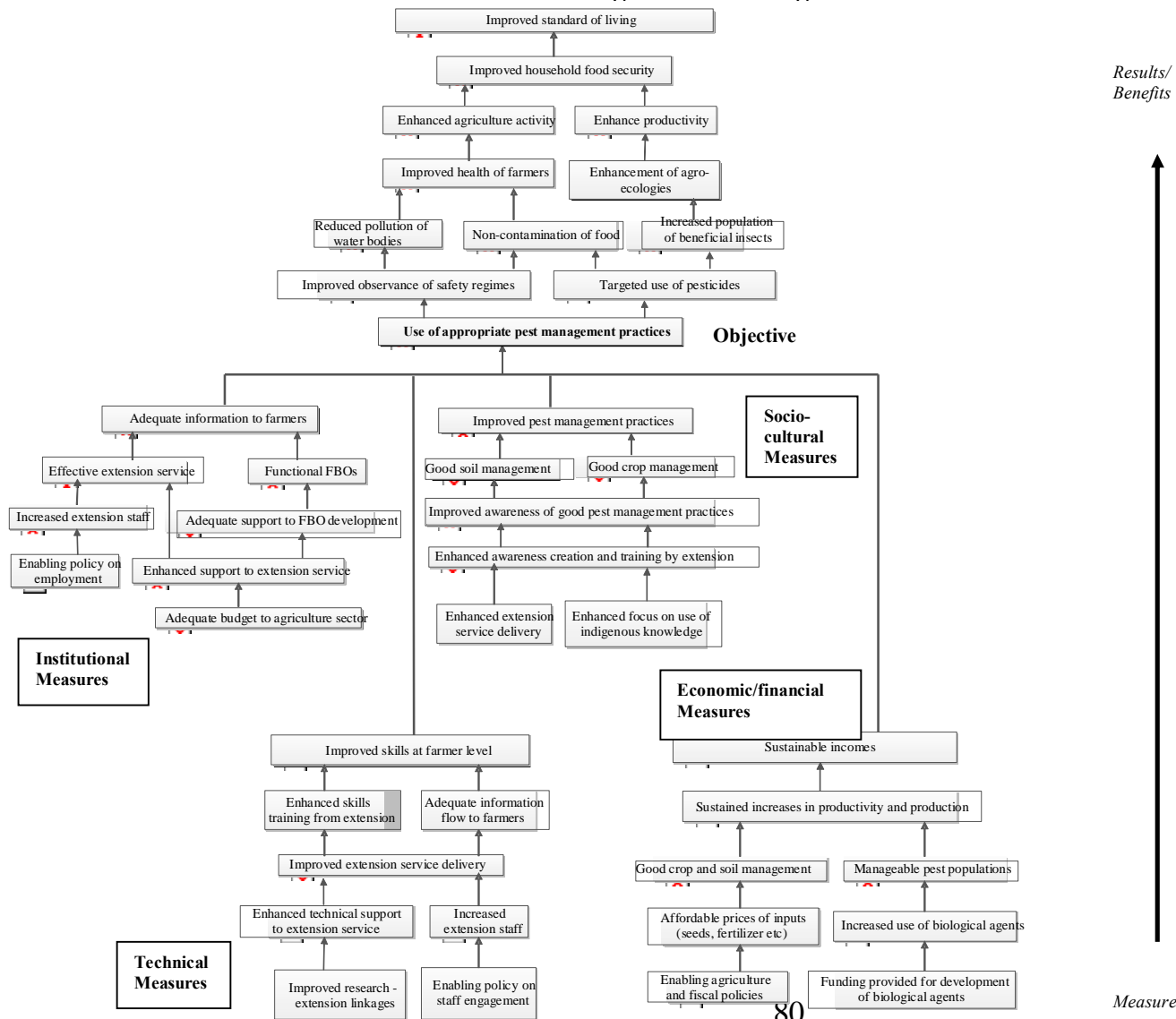


H. Ecological Pest Management

Barrier Tree for Ecological Pest Management



Measures Tree for Ecological Pest Management



Annex II. List of stakeholders involved and their contacts

The stakeholders listed below were all consulted at a 3-day national workshop organised for the purpose of barriers and measures identification and analysis of the enabling frameworks for the prioritised adaptation technologies in the water and agricultural sectors.

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Annex III. Policy Factsheets

Name of Policy	National Climate Change Policy
Name of Field	Climate Change
Effective Date	Completed in September 2012 and yet to receive parliamentary approval
Date Announced	September 2012
Date Promulgated	It is a national document as prepared by the sector ministry; expected to be promulgated by Parliament in 2013
Date Ended	Just began.
Unit	Climate Change
Country	Ghana
Year	To be implemented from 2013
Policy Status	In force
Agency	Ministry of Environment, Science and Technology (MEST)/ Environmental Protection Agency (EPA)
Funding	Expected funding from Government of Ghana and development partners
Further Information	The policy is linked to the Ghana Shared Growth and Development Agenda downloadable at http://www.ndpc.gov.gh/
Enforcement	By EPA
Penalty	Penalties for non-compliance with policy may be carried out under the Act 490, 1996.
Policy Superseded by	None
Policy Supersedes	None
Stated Objectives	The key objectives of the policy is to ensure effective management and conservation of terrestrial and aquatic ecosystems by appropriate agencies to improve the resilience of aquatic and terrestrial ecosystems to climate change.
Evaluation	Not yet
Policy Type	National; climate change
Policy Target	All sectors of the economy e.g. agriculture, water, energy and industry
URL	http://www.ghana.gov.gh/index.php/governance/ministries/329-ministry-of-environment-science-a-technology http://www.epa.gov.gh
Legal References	
Description	Among the major areas of focus in the Policy document are the overview of climate change in Ghana, the importance of climate change matters to Ghana and the guiding principles. Furthermore the Policy also focuses on adaptation, social development and mitigation. The policy hinges on seven pillars which are Governance and co-ordination, capacity building, science, technology and innovation, finance, international cooperation,

	information, communication and education, monitoring and reporting. The adaptation component of the report highlighted on technological needs in the water and the agriculture sectors. The four thematic areas are Energy and Infrastructure, natural resources management, agriculture and food security and disaster preparedness and response.
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Name of Policy	National Water Policy
Name of Field	Water Sector
Effective Date	June 2007
Date Announced	2007
Date Promulgated	2007
Date Ended	No planned end date but the policy accommodates regular updates to incorporate social and environmental changes
Unit	Water policy management
Country	Ghana
Year	2007
Policy Status	In force
Agency	Ministry of Water Resources, Works and Housing
Funding	Not indicated
Further Information	Further information can be obtained from the Water Resources Commission
Enforcement	The Ministry of Water Resources, Works and Housing oversees implementation
Penalty	
Policy Superseded by	None
Policy Supersedes	None
Stated Objectives	Policy focus area 6 deals with climate variability and change. The objectives include; i) to minimize the effects of climate variability and change ii) to institute measures to mitigate the effects of, and prevent damage caused by extreme hydrological occurrences (floods and droughts) iii) develop and strengthen human resources and institutional and operational capacities iv) to promote the generation and wide dissemination of information on integrated water resources management to the general public.
Evaluation	Not yet
Policy Type	Sectoral
Policy Target	The policy targets key collaborating institutions such as; i) Water Research Commission, ii) Water Research Institute, iii) Ghana Water Company iv) Community Water and Sanitation Agency v) Ministry of Local Government

	and Rural Development vi) District Assemblies vii) Electricity Company of Ghana viii) Town and Country Planning ix) Environmental Protection Agency x) Ghana Irrigation Authority xi) Ghana Standards Authority and other allied institutions
URL	http://epa.gov.gh/ghanalex/policies/NATIONAL%20WATER%20POLICY.pdf http://epa.gov.gh/ghanalex/policies/NATIONAL%20WATER%20POLICY.pdf
Legal References	
Description	The policy spells out Ghana's water vision for 2025 with the main objective of promoting an efficient and effective management system and environmentally sound development of all water resources in Ghana. It adopts the Integrated Water Resources Management (IWRM) system to enhance sustainable management.

Name of Policy	Food and Agriculture Sector Development Policy (FASDEP II)
Name of Field	Agriculture Sector
Effective Date	2009
Date Announced	
Date Promulgated	2009
Date Ended	
Unit	Agriculture; Climate Change
Country	Ghana
Year	2009
Policy Status	Policy is currently in operation
Agency	Ministry of Food and Agriculture (MoFA)
Funding	Government of Ghana and development partners
Further Information	Detailed information could be obtained at the Ministry of Food and Agriculture (MoFA); The following policies are very useful and related: the Growth and Poverty Reduction Strategy (GPRS I & II), The Food and Agriculture Sector Development Policy and FASDEP I. It is also related to the METASIP and the Ghana ECOWAP Compact which are designed to ensure the implementation of the FASDEP II.
Enforcement	The policy is public document with legal enforcement status. MoFA is the lead Agency to ensure enforcement. Other Ministries, Departments and Agencies (MDAs) have legal mandate to ensure the enforcement of their respective portions in the FASDEP II implementation.
Penalty	
Policy Superseded by	
Policy Supersedes	FASDEP I
Stated Objectives	The objectives for the food and agriculture sector policy are as follows:

	<ul style="list-style-type: none"> · Food security and emergency preparedness; · Improved growth in incomes; · Increased competitiveness and enhanced integration into domestic and international markets; · Sustainable management of land and environment; · Science and Technology Applied in food and agriculture development; · Improved Institutional Coordination;
Evaluation	None yet
Policy Type	Sectoral
Policy Target	The main target group is farmers (fishermen, crop farmers and animal husbandry). However, in the quest of reaching the key target group, the policy targets stakeholders such as the MDAs, private sector, civil society and the development partners.
URL	http://mofa.gov.gh/site/?page_id=598 http://www.nepad-caadp.net/pdf/Ghana.pdf http://www.caadp.net/pdf/Investment%20Plan%20Documents%20-%20Ghana.pdf
Legal References	
Description	The national vision for the food and agriculture sector is a modernised agriculture culminating in a structurally transformed economy and evident in food security, employment opportunities and reduced poverty. The revised policy (FASDEP II) emphasises the sustainable utilization of all resources and commercialisation of activities in the agric sector with market-driven growth in mind. It targets fewer commodities for food security and income diversification, especially of resource poor farmers. Enhancement of productivity of the commodity value chain, through the application of science and technology, with environmental sustainability is emphasised. Greater engagement of the private sector and collaboration with other development partners is pursued to facilitate implementation of the policy. The policy has a well designed and comprehensive results based M&E plan.

Name of Policy	National Policy on Public Private Partnership (PPP)
Name of Field	Public-Private Partnership
Effective Date	June, 2011
Date Announced	
Date Promulgated	June 2011
Date Ended	
Unit	Partnerships
Country	Ghana
Year	2011
Policy Status	In force

Agency	Ministry of Finance and Economic Planning has prime responsibility for implementation with specific units set up in the ministry for this; implementation will involve Government Contracting Authorities, General Assembly of Metropolitans, Municipalities and District Assemblies, public procurement authorities, Ministry of Trade and Industry, Cabinet, Parliament, PPP Approval Committee, Attorney Generals Department Regulatory Authorities(e.g. Public Utilities Regulatory Commission, Water Resources Commission, Ghana Railway Development Authority, etc)
Funding	An amount of at least US\$1.5 billion is required annually for the next decade.
Further Information	The document is related to the National Energy Policy, The Climate Change Policy, The Ghana Water Policy, FASDEP and sectoral policies of Ghana
Enforcement	The laws and regulations governing the establishment of the MMDAs
Penalty	Penalties defined by the Criminal Code
Policy Superseded by	None
Policy Supersedes	Policy supersedes the 2004 Policy Guidelines
Stated Objectives	The key objectives are to a) leverage public assets and funds with private sector resources from local and international markets to accelerate needed investments in infrastructure and services; b) encourage and facilitate investment by the private sector by creating an enabling environment for PPPs where value for money for government can be clearly demonstrated; among other objectives
Evaluation	Climate change mitigation; Market transformation; Advancing industrial competitiveness; Commercial viability; Securing new revenue; etc.
Policy Type	National policy
Policy Target	Policy generally targets investors in all sectors with potential for infrastructural services e.g. roads and highways, energy generation and distribution, telecommunication services, water and agricultural sectors.
URL	www.mofep.gov
Legal References	The laws and regulations governing the establishment of the MMDAs
Description	This policy deals with concept, roles and responsibilities, the process and contract management in PPP arrangements. The content of the PPP policy specifies objectives, principles, institutional and legal frame work. Furthermore, it deals with the process for Government originated projects, agreements and its amendments, concessions and finally the review the partnerships. The policy is structured to encourage the provision of a wide variety of quality and timely public infrastructure and services. It will be achieved through faster project implementation, maximum leveraging of public funds, enhanced accountability and a shift to whole-life cycle costing and infrastructure management by the private sector.