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# Assessment of the Perception of Development Agents on the Impact of Integrated Watershed Development Practices on Yield and Land Productivity in SNNPRS, Ethiopia

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**Abstract**

Land degradation, particularly soil erosion in Ethiopia is a serious challenge in reduction of fertility status of soil, declining agricultural yields and a problem in food security and livelihood of farmers, of Southern Nations, Nationalities and Peoples' Regional State(SNNPRS) as a whole a country. To combat problem of soil erosion, yield reduction and low fertility status of soil: improvement and conservation of natural and ecological environment, through the implementation and sustainable utilization of integrated watershed management development activities (IWSDA) are paramount important. Despite the massive mobilization of resources for this program, in the study there are few studies regarding the effectiveness of interventions and also in selected areas gaps observed regarding on the success of interventions to improve soil fertility and yields of agriculture on difference agro-ecological, topographic, other biophysical and technical conditions. So in this research analyze the perception of Development agents on the impacts of activities with respect to improving fertility status of cultivated lands and agricultural yield of farmers in SNNPRS, Ethiopia. A semi- structured questionnaire for individual and focus group discussions were used to generate data.

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Data were collected from randomly selected and stratified 120 development agents (DAs), who were on job training in Dilla University. In the descriptive analysis, 85% of DAs reported that IWSDA have a positive outlook and its effect observed on increasing crop yield and fertility status of soil. Generally to improve the sustainable utilization, implementation and maintenance of integrated watershed development practices: on farm training should be designed to DAs in order to improve skills about the design, layout, specification of different soil and water conservation technologies, incentives and motivation should be provided by Governments and the watershed development approach should be participatory.

***Keywords:*** Perception; Soil Erosion; Integrated watershed development; Development Agents & Southern Region.

## 1. Introduction

Ethiopia is an agrarian country on which agriculture provides 47% of the gross domestic product (GDP), 80% of the employment and 60% of the export commodity [24]. Most of the country's populations live in rural areas and derive their livelihoods from agricultural activities and the economy mainly depends on agriculture.

Natural resource degradation is the main environmental problem in Ethiopia. The degradation mainly manifests itself in terms of lands where the soil has either been eroded away and/or whose nutrients have been taken out to exhaustion without any replenishment, deforestation and depletion of ground and surface water. The majority of the farmers in rural areas of Ethiopia are subsistence-oriented, cultivating impoverished soils on sloppy lands that are susceptible to soil erosion and other degrading forces. Crop production is constrained not only by low input utilization and low technology level but also by land fragmentation and soil erosion.

Cognizant the problem of land degradation, particularly soil erosion, the government of Ethiopia designed a strategy of watershed development program a decade ago, not only related to improvement and conservation of the environment but also it is a key factor for sustainable development of the agriculture sector and the economy of the country at large. Different soil conservation technologies with different approaches have been implemented focusing on highly affected areas the highlands of the country where it needs urgent measures to threat problem of land degradation, particularly soil erosion. Integrated watershed development program, particularly soil and water conservation activities can change the physical conditions of the soil like soil organic matter content, soil structure, and water holding capacity, soil bulk density, soil porosity, soil pH and its workability [20]. Despite the massive mobilization of resources for integrated watershed development programs, studies indicated that gaps regarding on the effect of interventions on difference agro-ecological, topographic, other biophysical, technical and socio-economic conditions. Also very few studies have been done to analyze the perception of Development agents(DAs) on the impacts of programs with respect to improving fertility status of cultivated lands, agricultural yield of farmers and rehabilitation of degraded lands. Therefore, to analyze problems, filling gaps and to support the country's effort in combating land degradation, and improving the food security and sustainable livelihood of our farmers as a whole a country, assessment of perception of DAs on the impact of integrated watershed development activity to improve fertility status and increasing yield of farmers in the study area is of paramount important.

## 2. Materials and methods

### *2.1. Description of the Study Area*

SNNPRS is one of the nine political regions of Ethiopia. The region borders Kenya to the south, South Sudan to the west, Gambela region to the northwest, Oromia region to the north and east. The region is divided in to 14 zones (Bench Maji, Dawro, Debub Omo, Gamo Gofa, Gedeo, Gurage, Hadiya, Kaffa, Kanbata Tambaro, Segen, Shaka, Sidama, Silte, Wolayita) and 4 special weredas (Alaba, Basketo, Konta and Yem) [17].

According to the Ethiopia's Central Statistical Agency (CSA) census in SNNPR has a total population of 15.04 million of which 89.72% of the people are living in rural areas and 10.28% are urban dwellers [3]. The population density ranges from 4 to 900 persons per square kilometer. The average land holding size of the region is estimated to be 0.75 ha which lies below the national average (1.2 ha) [4]. The region has a diversity of agro-ecological zones, ranging from Moist Kolla (semi-arid) at south Omo to Wurch in Gamo Gofa zone. Accordingly, the lowland area (mainly part of south omo zone) of the region receive less than 600 mm annual rainfall and highlands of Shaka, Kaffa, Dawro, Wolayita, KambataTambaro, Sidama, and Gamo Gofa zones receive more than 1200 mm per year [18]. Average temperature of lowland exceeds 20°c and about 28°c is reported for extremely hot area. Average temperature of 10–20°c is recorded for highland areas, for which less than 10°c also exists. The State/region has topography of an undulating land feature dissected by the Omo river basin into western and eastern parts. The elevation ranges from 376 to 4, 207 meter above sea level. The lowest area and highest peaks in the State is recorded near Lake Rudolf in South Omo and at Mount Goge in North Omo, respectively. Owing to its diverse agro-ecological zones, range of plant species grow in the region. The region is rich in perennial crops such as Ensete ventricosum, Coffee arabica, and Catha edulis. Cereal crops such as Triticum aestivum, Hordeum vulgare, Zea mays, Sorghum bicolor, Eragrostis tef, Phaseolus vulgaris, Pisum sativum, Vicia faba, Ipomoea batatas and Manihot esculenta are widely cultivated in the region. Coffee based agroforestry is widely adopted. Planting fruit/tree species around homestead is commonly practiced. Soil types such as dystric nitosols, orthic acrisols, pellic vertisols, chromic luvisols, eutric fluvisols, eutric nitosols, mollic andosols, and chromic vertisols dominantly characterize different part of the region [17]. The three basins: Omo-Gibe, Baro-Akobo, and Rift valley lakes drain big area of the region. In the region there are different human interventions that expose the natural resource assets to continuous depletion and loss, among these agricultural mismanagement of soil and water resource: clearing of forests, removal of crop residue, overgrazing results high soil erosion hazard and reduction of productivity of land. In general most land areas of the region are comparatively degraded.

### *2.2. Methods of data collection*

For this study, Gedeo, Sidama, Gurage and Silte zones of development agents who have been on job training in Dilla University were purposefully selected. From each zone, seven woredas, except Silte and Gedeo Zone were selected. Because from Silte Zone only three woredas of DAs found on job training and Gedeo Zone have only six woredas. Also from each weredas seven DAs were selected for the questioner. Because in SNNPR, three to four development agents have been assigned at each *keble1* to give extension service about plant and livestock

production and management and protection of natural resources, especially giving frequent awareness creation about different technologies, giving technical support and advice to farmers. Moreover, the development agents are in place to demonstrate and disseminate natural resource management technologies. The data for this study were obtained from both primary and secondary sources. The primary sources mainly related to perception of development agents' on the impact of IWSD practices were collected by using questioners. All the necessary qualitative data required for the study were gathered through a respondent survey from September to November, 2015. At the beginning stage of the survey, informal meetings were undertaken with a group of DAs in order to understand the impact of integrated watershed development practices on crop production and land productivity of study area. Also, focus group discussion (DAs of different discipline, age and experience) were conducted to gain in-depth knowledge about the District activities and to pre-test the respondent survey questionnaire. Secondary sources are very crucial in order to full information gap from primary data sources. Secondary sources of information which was used for this study include published materials such as reports, plans, official records, census records, project reports, research papers and data files from web sites and offices of SNNPR, Agricultural offices of Regional, Zonal and Woreda level was used as additional sources of information. Thus, these are data collected by other people and that was used carefully by counter checking for their authenticity.

### *2.3. Sampling design and technique*

The study was adopted a descriptive survey design. This design was appropriate because it enabled the description and exploration of the integrated watershed development practices perceived its impact was assessed by respondents in the selected study areas. This research design was tried to obtain information that revealed. The sampling technique in this study was employed by purposive, simple random and stratified sampling techniques. The researchers purposely selected development agents, who have been on job training in Dilla University. Two stage sampling technique was used to select the respondents. First, the respondents were listed and distributed by their educational field of background and taking courses or trainings related to integrated watershed development practices. Second with considering their work experience on participation of IWSD practices. The main reason of using such kind of division was DAs who have a knowledge and experience on those IWSD practices, well understood and gave a clear idea about the intervention impact on yield and productivity of land. Accordingly, Out of 1200 development agents (DAs), ten percent (120) Sample DAs ,who have been on job training in summer Bachelor of Science(BSc) program in fields of Natural Resource Management, Plant Science and Animal Science were randomly selected and stratified based on their discipline and work experience. A semi- structured questionnaire and interviews were used for, individual respondents and focus group discussions respectively. To develop the DAs trust in the questioner, each respondent was well informed about the purpose of the survey and why he/she was chosen for the interview.

### *2.4. Methods of data Analysis*

The data collected from semi-structured questioners of individual respondents were analyzed using statistical package for social science for windows [18]. The quantitative data analyses were involved by calculation of frequencies, descriptive statistics. The information generated through focus group discussions were used to validate and supplement findings from the quantitative analysis of the semi structured questionnaires

## 3. Results and Discussion

### *3.1. Work experience and Educational background of Development Agents'*

Numbers of development agents' selected for the questioner were distributed based on their educational background and work experience related to watershed development activities. The distribution of development agents according to their areas educational background shows that 42% of the DAs majored in natural resource management, 33% in plant science and 25% studied animal science (Table 1). Out of the 100 DAs that participated in the study, 25% had no practical training in watershed management activities and 33% of the DAs who have been under training in plant science disciplines received some training especially in soil conservation techniques. The remaining 42% of DAs have taken SWC techniques during course work and on job training. Work experience of selected respondents also indicated that 88.5% of development agents' have a working experience of more than six years (Table 1). Thus this study has benefited to generate concrete result from the DAs experience, background, knowledge and skills on the impact of introduced IWSD activities to yield and productivity of land.

**Table 1:** Work experience and Educational background of Development Agents'

| **Education** | **No of Respondents** | **Percent** |
|---|---|---|
| Natural Resource Management | 50 | 41.67 |
| Plant Science | 40 | 33.33 |
| Animal Science | 30 | 25.0 |
| **Total** | **120** | **100.00** |
| | | |
| **Work Experience(year)** | **Respondents'** | **Percent** |
| 0-5 | 15 | 12.5 |
| 6-10 | 65 | 54.2 |
| 11-15 | 30 | 25.0 |
| >15 | 10 | 8.3 |
| **Total** | **120** | **100** |

Source Field data (2015).

### *3.2. Respondent's perception on reduction of yield and productivity of land*

The perception of development agents in areas of change of land productivity and drivers of the changes observed in the study area. In this regard, 100% of the respondent DAs have shown changes (decline) in land productivity of selected areas. Among different Perceived causes of land productivity reduction listed by DAs, eighty-nine percent of responded development agents reported that soil erosion is one of a major problem that has been observed for the last ten years on farmers' farmland (Table 2). Also respondent DAs recognized soil erosion as a problem constraining crop production and they reported that the most important top soil for crop production activity was deteriorating for the previous years due to erosion processes. Development agents expressed the opinion that the loss of soil from cultivated fields reduced the depth of the topsoil and lead to a reduced production potential. During focus group discussion participant Development agents were aware that the causes of soil erosion were: deforestation, steep-slope cultivation, continuous cultivation and human tracks,

all these are related to the mismanagement of the land resources such as soil and forests. This research finding is supported and agreed with the result of [12] indicated on their research that human-induced soil degradation by water erosion is one of the most destructive and certainly the most extensive phenomenon worldwide, and recognized as a key issue in threatening.

**Table 2:** Perceived causes of Land and productivity Reduction of Farmers Land

| **Perception of Development Agents on Reduction of Yield and Productivity** | | | **Proportion** of **total Respondents (%)** | |
|---|---|---|---|---|
| | | | Yes | No |
| Development Agents response on yield and productivity of land reduction perceived as a problem in farmers land | | | 100.0% | 0% |
| Observed causes of yield and productivity reduction response of DAs | DAs response | | | |
| | Yes | % | No | % |
| Shortage of input | 89 | 74.2 | 31 | 25.8 |
| Lack of credit facilities | 87 | 72.5 | 33 | 27.5 |
| Variability of RF | 103 | 85.9 | 17 | 14.2 |
| Disease of plants and animals | 97 | 80.8 | 23 | 19.2 |
| Soil erosion | 107 | 89.2 | 13 | 10.8 |
| Low extension service | 58 | 48.3 | 62 | 51.7 |
| Low level of farmers accepting technologies | 79 | 65.8 | 41 | 34.2 |

Source Field data (2015).

global food security. Also result indicated that the perception of the DAs as to the causes of soil erosion is in line with studies conducted by others [15], who report that the most frequent cause of soil erosion stem from excessive human pressure or poor management of the land, overgrazing, over-cultivation of crop land and deforestation, are the main problems. The findings of [2,5] in the western Ethiopian highlands, [6] ,in Tanzania, reflects soil erosion can cause a reduction in infiltration and the water holding capacity of the soil as well as a loss of plant nutrients and as a whole reduces production and productivity of land.

**Table3:** Types of IWSHD Activities implemented in farmers land

| **Name of implemented integrated watershed development measures, their ranks and percentage of responses** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **IWSD practices** | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th | 8th |
| Bunds and/or terraces | 90 | 8 | 2 | 0 | 0 | 0 | 0 | 0 |
| Contour plowing | 80 | 20 | 10 | 10 | 0 | 0 | 0 | 0 |
| Inter cropping | 75 | 23 | 2 | 0 | 0 | 0 | 0 | 0 |
| Micro water harvesting structures | 82 | 18 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cut-off drains | 12 | 18 | 15 | 5 | 20 | 10 | 17 | 3 |
| Waterways | 2 | 0 | 19 | 4 | 38 | 17 | 0 | 20 |
| checkdams | 22 | 36 | 0 | 33 | 5 | 4 | 0 | 0 |
| Planting trees | 70 | 21 | 3 | 4 | 3 | 0 | 0 | 0 |
| Others | 60 | 20 | 15 | 15 | 10 | 0 | 0 | 0 |

### *3.3. Perceived knowledge and importance of IWSD activities by Development agents*

Under the IWSDP (SWC) program, various types of physical and biological SWC measures have been undertaken in farm lands with full participation of the communities. These practices were soil bunds, *fanya juu* bunds, stone bunds, cut-off drains, check dams , micro water harvesting structures, planting trees, planting forage grasses and other agronomy and soil management practices. Out of these measures, 90% of DAs perceived as farmers were more willing to participate in implementation of soil bunds, check dams and micro water harvesting structures with the integration of trees and grass species on farmers cultivated, communal and degraded areas, followed by 82% of DAs considered that micro water harvesting structures, and contour plowings were practiced in farmers lands. Interestingly, only 2% of respondents show that artificial waterways were practiced in some parts of the study areas to safely evacuate excess water to natural waterway (Table 3). In general DAs perception on integrated watershed development practices, indicated that SWC practices are effective to reduce soil and water losses, especially helpful to to minimize soil erosion, reduce and stop the velocity of runoff, increase the infiltration of water, stabilizing crop yields, rehabilitation of degraded areas, improving soil fertility and increasing yield of farmers. reduce and stop the velocity of runoff, increase the infiltration of water, stabilizing crop yields, and rehabilitation of degraded areas, so as to increase food security through increased food production/ availability. These emphasize the importance of IWSD activities should not only aim at reducing soil erosion but also increase productivity within time frame and resources endowment of farmers' cultivable land. Several studies have shown that watershed management using integrated SWC measures can increase infiltration, directly decrease run-off and improve soil productivity [27, 29].

### *3.4. Perceived impact of Integrated Watershed Development Activities on Crop Yield and Productivity of Land*

Ethiopian government has designed a strategy and practiced integrated watershed development activities such as construction of physical structures (soil bunds, terraces and different water harvesting structures) , application of compost, agro-forestry practice and reforestation programs, to reduce runoff thereby reducing soil erosion and improving soil fertility of farm lands, degraded and marginal areas. So far development agents perceived that IWSDA have a positive effect to improve yield, livelihoods and food security of farmers as a whole our citizens.

### *3.5. Opinion on increasing crop yield*

Development agents' response concerning about the effects of constructed IWSDA mainly soil and water conservation (SWC) structures revealed that 85% of respondent DAs considered that IWSDA have a positive outlook and its effect observed on increasing crop yield, improving soil fertility, improving soil-water retention and thus prevent soil erosion, (Table 4). This finding is similar with the study of [14] who, stated that the introduced SWC measures were widely acknowledged and accepted as effective measures against soil erosion and as having the potential to improve land productivity. The result also agreed with [24], indicated that, integrated soil and water management program has a significant contribution in increasing crop productivity and hence, increase income to reduce food insecurity of smallholder farmers. The finding of [16], indicated that the majority of farmers on the study area, perceived that SWC measures increased crop yield, prevent soil erosion

and improved soil-water retention capacity of the soils. However, small number of DAs in the study areas reported that difficult to quantify the effectiveness of IWSD practices within a short period and also the other DAs depicted that, in some areas the implemented structures not following proper design and specification, this is due to the fact that *kebele* administration unwillingly forced farmers to participate in watershed development activities. As a result low percentage of DAs have an evidence to show that in some parts of areas the IWSD activities were less effective to control soil erosion, improving soil fertility and increasing yield of crops. This result agreed with the result of [22]. Also the finding of [16] assured that top-down enforcement of farmers to adopt mechanical SWC measures without giving awareness about the use, resulted less successful of measures to control soil erosion and maintain soil fertility.

### *3.6. Opinions on reduction of soil erosion*

72.5% of respondents perceived that role of IWSDA, particularly SWC measures have a positive effect to reduce runoff, minimizing soil loss and improving water retention ability, improvement of soil fertility and increase crop yields of farm lands and degraded areas. Focus group discussion (FGD) result also revealed that implementation of different SWC measures, besides reducing soil erosion on different farm lands also treat and rehabilitate gullies, reduce overland flows and soil loss of study areas. This finding confirmed with the findings of [2] reported that farmers acknowledged SWC measures are efficient techniques and effectives to reduce runoff and control soil erosion.

**Table 4:** Development Agents perceived impact on Integrated WS Dev't activities

| | DAs response | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Effects of IWDA | Strongly disagree | % | Dis agre | % | agree | % | Strongly agree | % |
| Increase yield | 6 | 5.0 | 12 | 10.0 | 81 | 67.5 | 21 | 17.50 |
| Increase soil fertility | 9 | 7.5 | 15 | 12.5 | 78 | 65.0 | 18 | 15.00 |
| Rehabilitation of gullies | 14 | 11.7 | 33 | 27.5 | 54 | 45.0 | 19 | 15.83 |
| Increase forest coverage | 7 | 5.8 | 10 | 8.3 | 77 | 64.2 | 26 | 21.67 |
| Decrease soil erosion | 5 | 4.2 | 12 | 10.0 | 79 | 65.8 | 24 | 20.00 |
| Decrease flooding | 24 | 20.0 | 29 | 24.2 | 45 | 37.5 | 22 | 18.33 |
| Improve water bodies | 19 | 15.8 | 26 | 21.7 | 48 | 40.0 | 27 | 22.50 |

Source Field data (2015).

### *3.7. Effects of Intervention on Soil Fertility*

Development agents evaluated fertility of soil in farmers land based on a diversified criteria and knowledge.

The survey result depicted that 66.7% of the respondents agreed IWSHD activities practiced on farmers land started to improve soil fertility and yield of farmers. Reference [23], asserted that integrated soil and water land management program has a significant contribution in increasing crop productivity and hence, increase income and food security of smallholder farmers. Reference [10] also revealed that 90.8% of the respondents on the study area reported on changes such as improvement in soil fertility and increase in yield. During FGD also assured that implemented integrated soil and water conservation measures a few years back, on the study areas, trap loss of soil and starting to improve soil fertility.

### *3.8. Constraints on the participation of SWC measures*

Soil erosion in the study area has been the major problem observed by DAs and farmers faced with. Integrated physical SWC measures have taken to minimize problems, however these measures are labor intensive, time taking and drudgery and requires high amount of labor. In terms of problems with the conservation activity, about 74% of the respondents observed problems of getting enough hand tools and shortage of labor to accomplish tasks within a given time, followed by 68% of DAs perceived farmers face problems to apply measures on their small plots of land and also the land was too hard to dig during implementation of physical SWC measures. Majority of respondents agreed IWSDA did not overlap with farming activities (Figure 4). The finding of [19], confirmed that without proper design of soil conservation schemes and inadequate consideration of labor in conservation activities might result in failure. DAs also noted in FGD, that most of farmers have small plot of lands, so they considered that integrated watershed development activities occupies cultivated land. Thus farmers are reluctant to participate on different SWC practices. In general, majority of the respondent DAs, face problems to organize and participate farmers in conducting watershed development activities especially soil and water conservation structures. The result of [1] showed that 68% of the respondents complained conservation practices compete for labor that could have allocated for other activities. Also [11] found that Labor constraints were as the dominant challenge among non-adopter farmers in sub-watersheds. A similar experience was also reported by [8]as cited by [11] also showed that soil bunds, *fanya juu* and stone bunds respectively demand a construction labor force of 150, 200 and 250 persons day-1 km-1.

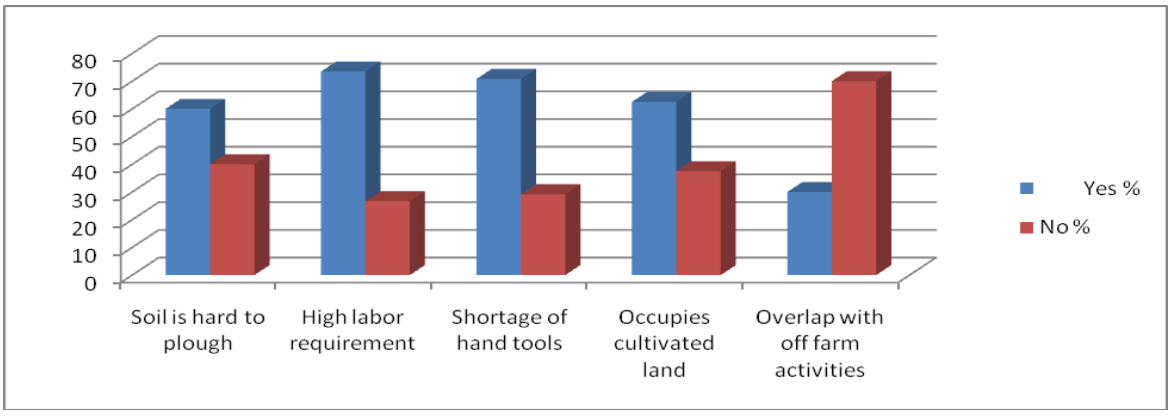


**Figure 4.1:** Constraints of integrated watershed development activities

## 4. Conclusion and Recommendations

The study evaluated the perception of Development Agents on the Impact of Integrated Watershed Development activities in SNNPRS, Ethiopia. Respondents were randomly selected from five zones and 26 woredas(Districts) The selected zones were Gedeo, Sidama, Welayta, Sility and Guragues. The questionery interview and focus group discussions of the present study depicted that, in the study area, integrated watershed development activities, particularly soil and water conservation practices, have a positive impact on combating soil erosion, and a potential for sustainable land management towards the improvement of agricultural yield and productivity of farmers land.

Based on the research, it was recommended that more efforts should be made to raise the DAs participation and skills by providing skillful training, incentives and motivation. And also participatory approach with farmers and properly giving trainings about the design, layout and implementation of physical soil and water conservation structures to selected farmers are very important to sustain the effectiveness of structures to increase yield, improve soil fertility and rehabilitation of degraded

Finally, governments at all levels need to support DAs and farmers in participating the implementation of IWSD introduced technologies by providing some basic facilities to DAs and improved seeds and seedlings, inorganic fertilizers, credit facilities, irrigation facilities, and technical advice through to farmers.

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