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RESEARCH ARTICLE

SUSTAINABLE MANAGEMENT OF WATER RESOURCE THROUGH PEOPLE'S ORGANIZATION!! HOW IT WORKS?

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ABSTRACT

Livelihood of rural population in Ethiopia depends on agriculture. However, due to water shortage and variations in rainfall, there is not enough water for most farmers to produce more than one crop per year and hence there are frequent crop failures due to dry spells and droughts. In order to tackle this problem and to intensify agricultural production, irrigation development has been developed in different parts of the country. To improve smallholder productivity and to promote smallholder commercialization, the formation of People's Organizations (Cooperatives) are also promoted all over the country. Thus, in order to utilize the water potential around Lake Ziway, irrigation cooperatives were organized to provide small scale motorized irrigation system through the government and NGOs with the aim of producing two to three times per year, increase members' income, and to deliver farm inputs and sale of outputs on aggregate to boost members bargaining power. However, no systematic and organized assessment on the contribution and performance of irrigation cooperatives towards the above mentioned aims are made so far. Thus the main focus of this paper is to assess the performance of irrigation cooperatives and its contributions to the members in enhancing their livelihood. The required data for the study were collected from 12 irrigation cooperatives and 230 randomly selected cooperative members. Structured interview was used as data collection methods. Performance indicators were developed to evaluate the performance of sampled irrigation cooperatives. Also indicators were developed to weigh the contribution of sampled irrigation cooperatives. T-test and chi-square statistical tools were employed to assess the contributions of irrigation cooperatives. Binary logistic regression model was used to identify the factors determining the performance of irrigation cooperatives. The results indicated that the contribution of irrigation cooperatives in the area is significant and 78% of sample cooperatives are not performed according to the expectation. Out of ten variables included in the binary logit model, five predictors such as education, irrigable land size, additional income, market information and union membership are found to be significant effect on the performance of irrigation cooperatives. Therefore, the respective development actors such as government, non-governmental organizations and cooperative members should work together on the identified factors to progress the performance of irrigation cooperatives so as to manage the water resource sustainably.

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INTRODUCTION

Ethiopia is predominantly an agrarian economy and agriculture is the source of livelihood and employment for 85% of the rural population; many of whom are poor (Adugna Eneyew; Ermias Alemu et.al, 2013). Vast majority of the rural poor rely up on rain-fed agriculture for their survival to highly variable and unpredictable rainfall. The sector contributes about 32 percent of the total GDP and smallholders cultivate 95 percent of the cropped area and produce 90-95 percent of cereals, pulses and oilseeds. Subsistence agriculture is almost entirely rain fed and yields are generally low. The rural agriculture continues to be a source for generating primary surplus to fuel the growth of other sectors of the economy.

Consensus has been reached by the government and donors that any solution to further reduces rural poverty must focus on increasing the production and productivity of smallholder agriculture (FDRE, 2018). Due to water shortage and large spatial and temporal variations in rainfall, there is not enough water for most farmers to produce more than one crop per year and hence there are frequent crop failures due to dry spells and droughts which have resulted in a chronic food shortage. In order to tackle this problem, irrigations have been developed in different parts of the country to intensify agricultural production. The irrigation schemes are of large-scale (commercial level wide area coverage) to small-scale family managed ones. In Ethiopia different locations have their own advantages in terms of access to infrastructure, central market

and natural resources (water, favorable climate and soil). East Showa zone in this respect is an important from the viewpoint of local and central markets. The Zone is endowed with several lakes and few rivers. There is also fluvisols of recent alluvial formation that suitable for farming in lakeshores of Lake Ziway to produce horticulture crops using irrigation. There is several small scale irrigation schemes developed in the East Showa Zone. To utilize the stated resources for the benefit of the local people, the government and NGO's are organized farmers in to irrigation cooperatives; where farmers pool their resources for mutual economic benefit. With the intention of achieving food security among the cooperative members, increasing income through production of high value crops to get good income and to sell the product on aggregate in order to increase their bargaining power among the cooperative members (ATWCPDO, 2015). Farmer members of many Irrigation Cooperatives are cultivating more than two crops in a year. The Irrigation Cooperatives block and accumulate the stream water and pump for irrigation as per the pre-planned and accepted schedule. They share the fuel and motor operator's expenses.

There are problems faced by the members of irrigation cooperatives; some of the river users faced water shortage during dry season in which intensive horticultural activity is undertaken. Also most of the water users' cooperatives have face problems i.e. siltation of irrigation canals which takes water from Lake to the water pump and shrinking of Lake. The other problem related with irrigation cooperatives is management of irrigation pump i.e. frequent failure reported on these motor pumps (Badiru Bashir, 2004). Based on the principles of cooperatives, irrigation cooperatives are expected to perform their irrigation activities and provide the necessary services to their members. But on the contrary most of the diesel pumps were not functional, some of the cooperatives were separated, some members were rented their irrigated land for commercial farmers, others use their own small diesel pumps to irrigate their farm. In spite of the government and NGOs commitment to a wide range of investments in irrigation infrastructure and technology, there is still a huge gap among irrigation cooperatives in managing these investments, particularly irrigation pumps and canals and coordinating the intended two to three times regular production. Thus, the above conditions need to be investigated thoroughly by conducting in-depth research so as to gather information and identify the factors affecting the performance of irrigation cooperatives in the study area. Hence this research is warranted.

Specific objectives

- To assess the performance of irrigation cooperatives in the study area
- To assess the contribution of the irrigation cooperatives for its members in their livelihood improvement
- To identify the factors determining the performance of irrigation cooperatives in the study area.

Methodology Followed: To address the framed objectives, a descriptive research design was used. Both primary and secondary data were used and the primary data was gathered using semi-structured interview schedule. To select the district, cooperatives and the sample respondents, multi-stage sampling procedure was followed.

At first stage, Adami Tullu district was selected purposefully depending on the endowment of irrigation cooperatives and the problems stated in the background. At the second stage, twelve villages which have irrigation cooperatives were purposefully identified and six villages having cooperatives with more than ten years of experience were purposefully selected. At the third stage, twelve cooperative societies (two from one village) were selected by using simple random sampling techniques. Finally, 230 sample respondents were selected from sampled cooperatives by proportionate random sampling technique. To arrive the sample size, a simplified formula suggested by Yamane (1967), was used. In addition, focus group discussions and key informant interviews were also carried out to supplement the information. The collected data were analyzed using Statistical Package for Social Science (version 24) applying both descriptive statistics and econometric model so as to draw meaningful inferences. Descriptive tools such as mean, frequencies, percentages and standard deviations supplemented by qualitative analytical methods were used for categorizing, summarizing, interpretation and presentation of the data. In addition, logistic regression model was employed to identify the factors determine the performance of irrigation cooperatives so as to improve the livelihood of members in the study area.

Model Specifications: The appropriate statistical model is determined by the characteristics of variables that the researchers proposed to investigate. Under this study, the dependent variable "performance of irrigation cooperatives" has two possible outcomes "less performance" and "good performance". Such variables are characterized as dichotomous and these two outcomes are coded 0 and 1, respectively. Therefore, binary logistic regression analysis was adopted. Binary logistic regression makes no assumption about the distribution of the independent variables. The relationship between the predictor and response variables is not a linear function in logistic regression; instead, the logistic regression function is used, which is the log it transformation of p :

$$\log \left[\frac{p(x)}{1-p(x)} \right] = \alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k \quad (1)$$

Here α is called the "intercept" and $\beta_1, \beta_2, \beta_3$, and so on, are called the "regression coefficients" of X_1, X_2, X_3 and so on respectively. The odds of some event happening is defined as the ratio of the probability that the event will occur to the probability that the event will not occur. That is, the odd of an event is given by:

$$\text{odd}(E) = \frac{p(E)}{P(\text{not}E)} = \frac{P(E)}{p(1-E)} \quad (2)$$

The odds ratio, which is $Exp(\beta)$, is the factor by which odds (event) changes for a one unit change in X . The odds ratio is a measure of effect size, describing the strength of association or non-independence between two binary data values. It is used as a descriptive statistic, and plays an important role in logistic regression. Unlike other measures of association for paired binary data such as the relative risk, the odds ratio treats the two variables being compared symmetrically, and can be estimated using some types of non-random samples.

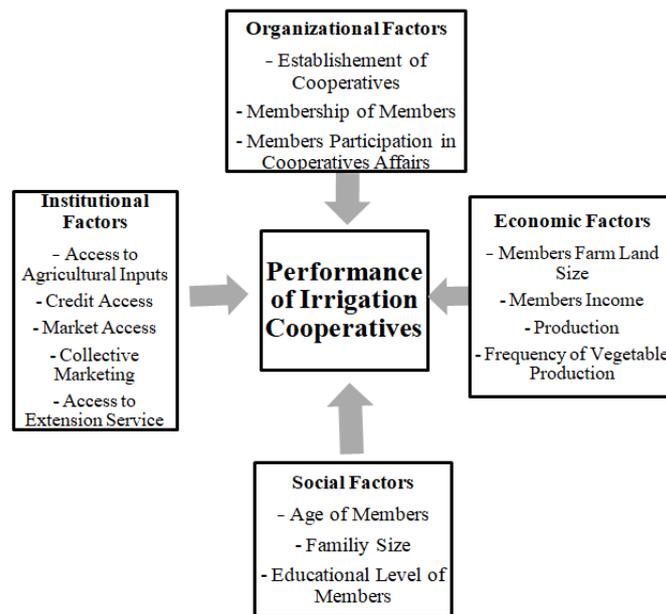


Figure 1. Conceptual Framework of the Study

Table 1. Performance of the irrigation cooperatives in line with the objectives

Variables	Frequency	Percentage
Collective action in the overall activities of cooperative	111	48.3
Supply of Agricultural inputs	160	69.6
Produce two to three times per year	228	99.1
Increasing members income by producing market oriented high value crops	62	27.0
Selling on aggregate basis	59	25.7
Fulfill all cooperative objectives	51	22.2

Source: Survey Data

Table 2. Credit Services

Variable	n	%
Need credit for irrigable agriculture		
Yes	194	84.3
No	36	15.7
Total	230	100
Availed credit services		
Always	0	0
Occasionally	76	33
Rarely	154	67
Total	230	100
Source of Credit		
Micro Finance Institutions	166	86
Traders	24	12
Cooperatives	04	02
Total	194	100

Source: Survey Data

Table 3. Distribution of Type of Farm Inputs

Types of Input	No. of Respondents	Percentage
Fertilizer	60	37.5
Improved vegetable seeds	71	44.4
Agro chemicals	29	18.1
Total	160	100

Source: Survey Data

Table 4. Access of Extension Services

Types of Extension service	n	%
Improved agronomic practice and water application	77	43.0
Fertilizer, chemical and water application	42	23.5
Post-harvest management and water application	31	17.3
All	29	16.2
Total	179	100

Source: Survey Data

The estimated odds are simply the ratio of the estimated proportions for the two possible outcomes. If \hat{P} is the proportion for one outcome, then $1-\hat{P}$ is the proportion for the second outcome:

$$ODDS = \frac{\hat{P}}{1-\hat{P}} \quad (3)$$

This is the ratio of the probability of occurrence of an event to the probability of non-occurrence of the event. Since logistic regression calculates the probability of success over the probability of failure, the results of the analysis are in the form of odds ratio. Logistic regression also provides knowledge of the relationships and strengths among the variables.

Conceptual Framework: Water resource management in agriculture is a critical contributor to the economic and social development of Ethiopia. If successful, irrigation could represent a cornerstone of the agricultural development of the country, contributing billions to the economy and potentially moving millions of households into food security. However, irrigation is not a simple silver bullet: first, it can only work if other components of the agricultural system are also effective (e.g., seeds, extension); second, all the tools in the toolkit will be required from small scale irrigation to large scale schemes to construct a viable solution. Promotion of irrigation cooperatives shows how the country can chart a practical path of initiatives that will allow it to support the scale-up of its irrigated agricultural sector, the growth of its small holder farmers, and the transition of its community to food and water security.

RESULTS AND DISCUSSION

The Performance of Irrigation Cooperatives: As defined in methodology part, the performance of irrigation cooperatives was assessed in terms of organizational and functional performances. The study area is rich in surface and ground water potential and known in its vegetable production. Most of the irrigation cooperatives of the area organized to achieve predefined objectives including collective action in the overall activities of cooperatives, produce two to three times per year, increasing members income by producing market oriented high value crops, selling on aggregate, avail agricultural inputs to the members, etc... The results indicate that about 22.2% of the sample irrigation cooperatives which is considered as good performers based on the achievements of stated objectives and this implied that the majority of irrigation cooperatives were not performing well. The focus group participants also ascertained this result.

Organizational Performance: Organizational performance of irrigation cooperatives refers to the way organized, established, and registered as a cooperative. Based on the data obtained from the members, establishment of cooperatives, and participation of members in cooperative affairs were assessed.

Establishment of Cooperatives: Cooperative is an association of persons who have voluntarily joined together to a common end through the formation of a democratically controlled organization, making equitable contribution to the capital required and accepting a fair share of the risks and benefits of the undertaking, in which the members actively participate

(FCA, 2007). The establishment of any cooperative has to be by self-initiatives of the members to address members' common need and to solve common problems. However, the survey results showed that all of the sampled irrigation cooperatives were not established by self-initiatives of the members rather quite the reverse, 58.7% and 41.3% of them organized by the government and NGOs respectively. Cooperatives organized and tightly controlled by government, as instrument of state economic policy are rarely conducive to the development of democratically controlled, member owned cooperatives (Coward, 2004 Cited in Mohamud, 2008). Because they are created to serve the objectives of politicians and planners; on which their objectives may or may not coincide with members who have little effective control of the cooperatives.

Participation of Members in Cooperative Affairs: Active involvement of members has an indispensable effect in the overall results of cooperatives. Participation means motivating people and increasing members understanding and capability in order to response development plans and in other words, participation involves people interference in decision making process, plans performing and sharing the interest of development plans, and interfering in the evaluation of plans (Papeli-yazdi and Labbaf-khaniki, 2001, Cited in Mohammad Reza Shahraki, 2011). In a democratic organization like cooperatives, the general body is supreme organ of the organization and the management committee is elected by the members to look after the day to day affairs. As can be seen from the results, 89.1% of cooperative members involved in the election of the respective management committee, among them 68.7% participated occasionally and 20.4% participated regularly. This implies that most of the cooperative members were not regularly participated in management committee election. 67.8% of cooperative members were not participated in any of meeting of the general assembly regularly, 52.2% of members were not participated in annual plan preparation, 57% was not participated in evaluation and approving executed activities report and also 52.2% were not participated in approving the audit report of the cooperatives. This shows that the trend of members in decision and exercising their democratic rights was poor. By-law is an important institutional aspect to practice democratic and autonomous governance and is a set of written rules formulated by the cooperative members and uses the by-law to govern itself. According to 62% and 19% of sampled respondents by-laws was formulated by the government and NGOs respectively.

Functional Performance: Irrigation cooperatives' functional performance refers to the accomplishment of activities for the benefit of members. Hence functional performance was assessed in terms of creating market access, credit access, access to extension service and input supply.

Creating Market Access: Many farmers in sub-Saharan Africa face difficulty when bring their products to the market. They also complain about the low level of profit that they are able to earn from their products. Important complaints are 'erratic price fluctuations,' 'unstructured markets' and 'disorganized supply chains'. In order to confront these difficulties, farmers and their institutions are developing collective and individual strategies (Anne Lothore and Patrick Delmas, 2009). Thus, one of the objectives of irrigation cooperatives is to increase their bargaining power so as to appeal buyers and collectively market their products.

Table 5. Collection Center, Employment and Transportation Service

Variables	<i>n</i>	Percentage	Test Prop.	p-value
Collection center				
Yes	20	0.09	0.5	0.000
No	210	0.91		
Farm employment				
Yes	131	.57	0.5	0.041
No	99	.43		
Transportation service				
Yes	6	.03	0.5	.000
No	224	1.00		

Source: Survey Data

Table 6. Annual Average Sales Before and After Cooperative Membership

Annual average sales in Birr	Before Membership		After Membership		t-test (p-value)
	<i>n</i>	%	<i>n</i>	%	
7000- 27300	121	52.6	13	5.7	
27301- 47300	83	36.1	82	35.6	
47301- 67300	20	8.7	58	25.2	28.21
67301- 87300	04	1.7	45	19.6	(0.000)
87301 and above	02	0.9	32	13.9	
Total	230	100	230	100	
Mean(SD)	28420 (13650)		52220 (19110)		

Source: Survey Data

Table 7. Crop Diversification Before and After Cooperative Membership

Crop Diversification	Before Membership		After Membership	
	<i>n</i>	%	<i>n</i>	%
Cereals only	198	86.1	-	-
Cereal and vegetables	23	10.0	212	92.2
Cereal, vegetables and fruits	09	3.9	18	7.8
Total	230	100	230	100

Source: Survey Data

Table 8. Members Contribution & Maintenance Service

Variable	No. of Respondents	Perce tage
Members Contribution for Pump Maintenance		
Always	155	67.4
Occasionally	65	28.3
Rarely	10	4.3
Total	230	100
Maintenance Service Providers		
Cooperative Union	24	10.4
Primary Cooperatives	6	2.6
Individual Mechanics	164	71.3
Individual cooperative Members	36	15.7
Total	230	100

Source: Survey Data

Table 10. Type of Training and Providers

Variable	No. of Respondents	Percentage
Training availed		
Yes	52	22.6
No	178	77.4
Total	230	100
Types of training		
Cooperative management	31	59.6
Financial management	21	40.4
Total	52	100
Training providers		
NGOs	14	26.9
District Cooperative office	26	50.0
Cooperative Union	12	23.1
Total	52	100

Source: Survey Data

Table 11. Frequency of Crop Production before and after Cooperative Membership

Frequency of Crop production	Before Membership		After Membership		t-test (p-value)
	<i>n</i>	%	<i>n</i>	%	
Nil	59	25.7	Nil	-	43.35 (0.000)
One time	169	73.5	02	0.9	
Two times	02	0.9	207	90.0	
Three times	Nil	-	21	9.1	
Total	230	100	230	100	
Mean(SD)	1.01 (0.11)		2.11 (0.31)		

Source: Survey Data

Table 12. Annual Average Production Before and After Cooperative Membership

Annual average production(Qt.)	Before Membership		After Membership		t-test (p-value)
	<i>n</i>	%	<i>n</i>	%	
10-39 quintal	116	50.4	07	3.0	27.37 (0.000)
40-69 quintal	86	37.4	85	37.0	
70-99 quintal	21	9.1	60	26.1	
100-129 quintal	05	2.2	45	19.6	
130 and above	02	0.9	33	14.3	
Total	230	100	230	100	
Mean(SD)	40.7 (19.6)		84.5 (27.4)		

Source: Survey Data

Table 13. Annual Average Income Before and After Cooperative Membership

Annual average income from irrigable agriculture(Birr)	Before Membership		After Membership		t-test (p-value)
	<i>n</i>	%	<i>n</i>	%	
0-30000	124	53.9	83	36.1	24.549 (0.000)
30001-60000	65	28.3	85	37.0	
60001-90000	25	10.9	30	13.0	
90001-120000	14	6.1	22	9.6	
120001-150000	2	.9	10	4.3	
Mean(SD)	36430 (27734)		50297 (33674)		

Table 14. Annual Saving Amount Before and After Cooperative Membership

Saving amount in birr	Before Membership		After Membership		t-test (p-value)
	<i>n</i>	%	<i>n</i>	%	
0-10000	123	53.5	69	30.0	28.21 (0.000)
10001-20000	82	35.6	78	33.9	
20001- 40000	22	9.6	46	20.0	
40001- 60000	-	1.3	28	12.2	
60001 and above	-	-	09	3.9	
Total	230	100	230	100	
Mean (SD)	12143 (6245)		20786 (9891)		

Source: Survey Data

Table 15. Results of Binary Logistic Regression Model

Variables	B	SE	Wald	P-value	Odds Ratio
Educational level	0.179	0.201	0.786	0.375	1.195
Irrigable land size	0.111	0.405	0.075	0.784	1.117
Farm inputs	1.761*	0.685	6.611	0.010	5.821
Extension service	2.082***	0.519	16.082	0.000	8.019
Additional income	0.542	0.288	3.525	0.060	1.719
Market information	0.063	0.579	0.012	0.913	1.065
Market linkage	1.746**	0.535	10.667	0.001	5.732
Members participation	1.073*	0.522	4.219	0.040	2.923
Collective marketing	1.265*	0.567	4.973	0.026	3.544
Union membership	0.925	0.498	3.446	0.063	2.521
Constant	-12.269	2.667	21.164	0.000	0.000
Chi-square	101.52				
p-value	0.000				
Pseudo R ²	0.547				
Df	10				

Note: B= Regression coefficient (Estimate), SE=Standard Error, *, ** and *** refers to the significance level at 5%, 1% and 0.1% respectively

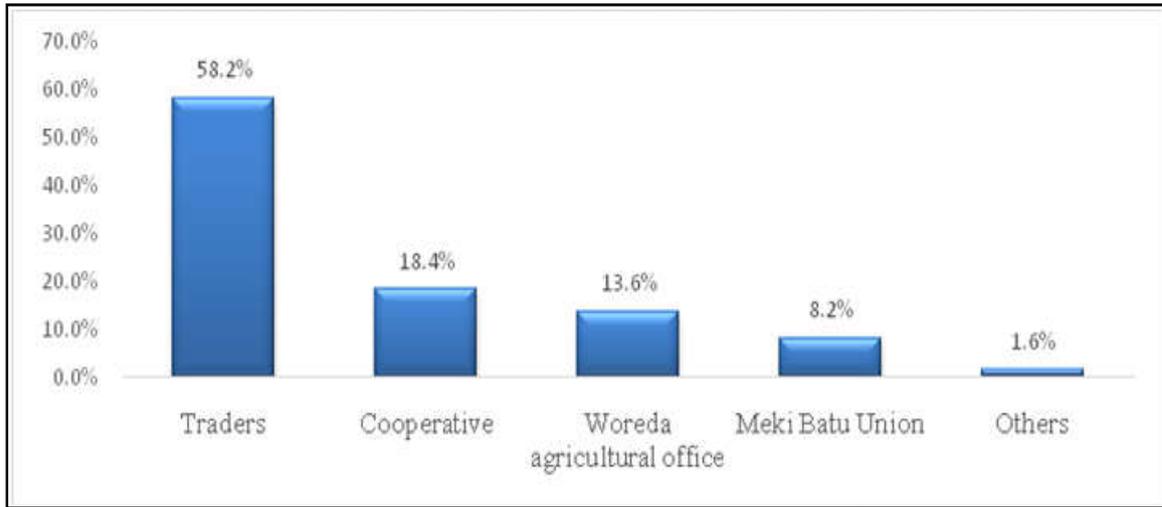


Figure 2. Sources of Farm Inputs

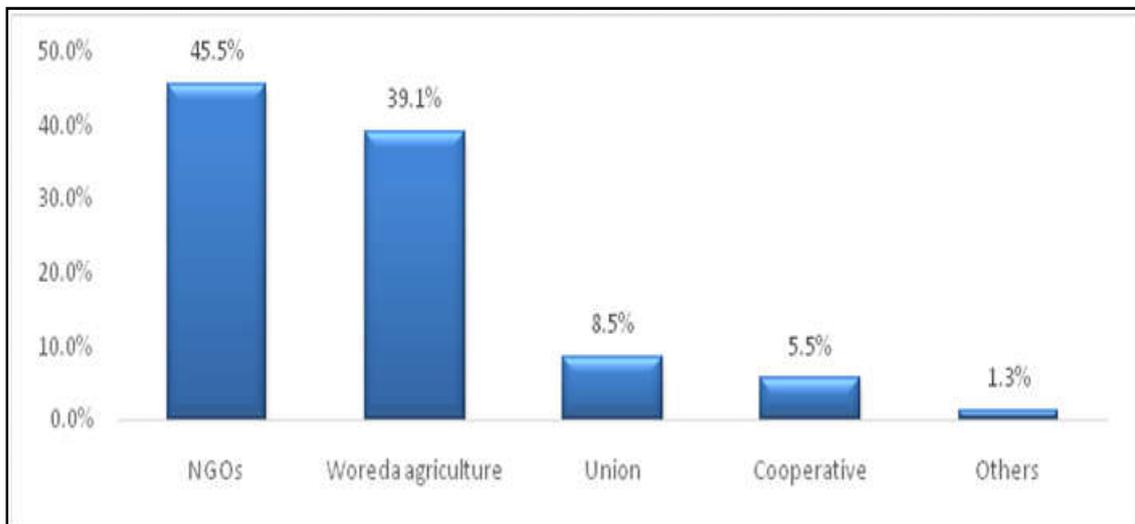


Figure 3. Sources of Extension Service

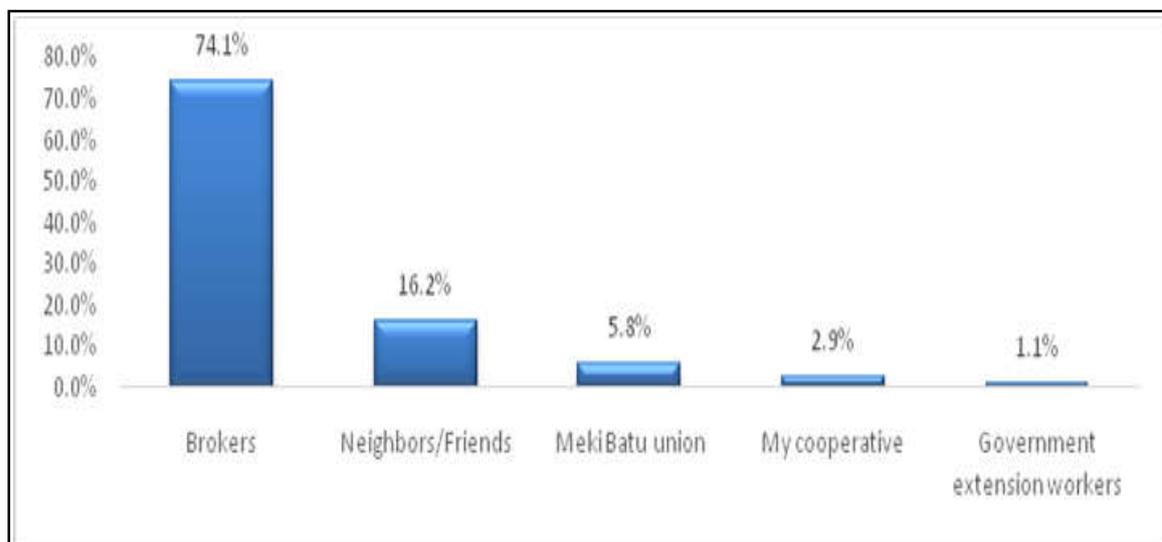


Figure 4. Source of Market Information

However, the results indicate that 89.6% of cooperative members were sold their vegetable products to the whole sellers, local traders, or directly to consumers individually, rather than selling collectively through the cooperatives. The market channel showed that 87.4% members of irrigation cooperatives were accessed market or linked with the buyers commonly through the brokers. Brokers and buyers come to the farm, set the price of horticultural products and collect the products. The survey result confirmed that 84.5% of members sold vegetable crops on farm individually, others selling to nearby market and tents found at the main asphalt road. This implies that these farmers' institutions were not created market access for vegetable products of the members.

Credit Access: Irrigable vegetable farming is capital intensive; capital access is required in order to finance the basic production costs such as agrochemicals and improved vegetable seeds which need to be paid. Farmers of the study area need credit to relax the financial constraints to utilize the necessary agricultural inputs and technologies basic for their irrigable vegetable crops production. Hence it is assumed that the sample irrigation cooperatives are supposed to provide credit facilities to support their members to smoothen their agricultural activities. As regards to the credit service, the survey result indicated that 84.3% of cooperative members need credit to finance their irrigable agriculture and to purchase the necessary agricultural inputs for horticultural crops production. Lack of finance/credit is significant in the area. To fill the financial constraints, farmers rely on different sources such as rural microfinance, traders, local money lenders and cooperatives. However, credit is rarely available from primary cooperatives; only 2 % of cooperative members received credit from their cooperatives. In most cases, farmers were obtained credit from micro finance institutions and 86% of the sample members were received credit from micro finance institutions. This shows that irrigation cooperatives have insignificant contribution in credit provision for their members.

The results of the key informants' interview and focus group discussions revealed that there are two credits providing micro finance institutions and they have different criteria, focuses, affiliations and pre-conditions to extending loans. Regardless of government and private banks in the areas neither of them provides credit for smallholder vegetable growers due to collateral requirement, fear of risk, etc. They further informed that cooperative members received credit from other sources like traders and local money lenders.

Supply of farm inputs: The irrigation cooperatives are expected to supply improved farm inputs such as improved varieties of seeds, fertilizers and other required materials to their members to increase the production and productivity. However, the results indicate that only 69.6% of the sample received farm inputs from different sources. This showed that irrigation cooperative members' usage of farm inputs such as improved vegetable seeds and agro chemicals for irrigable agricultural production has significant effect on the performance of their cooperatives. The results of the key informant interview revealed that access to and utilization of farm inputs is crucial for enhancing agricultural production and productivity, both in quantity and quality, consequently increase their income for livelihood. The survey results further show that among the sample members, 58.2% of them got improved agricultural inputs from local traders and only 18.4%

got from cooperatives. The result of focus group discussions and key informant interview also confirmed that cooperatives mainly supply seeds of maize, haricot bean and inorganic fertilizers namely DAP and Urea, less often supply some vegetable seeds and agrochemicals, but it was not proximate for the farmers. Therefore, most of the members of irrigation cooperatives mainly depend on local traders to obtain the necessary farm inputs such as vegetable seeds and agrochemicals for their crops production.

Access to Extension Service: Since most of the cooperative members are farmers and they are involved in agricultural production, extension service will enhance their capacity to understand the new technology for application in their respective field so as to improve their production and productivity and the cooperatives are responsible to provide such services. However, according to the responses from the sample members, majority (77.8%) has got extension service among them only 5.5% has got from cooperatives and the remaining got the service from other sources such as NGOs and Agricultural Offices. The focus group discussants revealed that irrigation cooperative members contacted at least once with NGOs and GO front line extension agents in a month. They focused on improved agronomic practices of vegetables, water, fertilizer and chemical applications. However, advisory services provided regarding horticultural crop production were inadequate and did not bring any considerable change in their production system. Regardless of the presence of the agricultural office, a big gap has been observed technically, especially in over utilization of chemicals and other agronomic practice, etc.

The Contribution of Irrigation Cooperatives for Members: In this section, the contribution of irrigation cooperatives for the members' such as farm employment creation, income growth, change in production, sales growth, improvement of bargaining power, training access, establishment of collection centers, maintenance of pumps, crop diversification, transportation service and saving increase were considered.

The Government of Ethiopia efforts to increase agricultural production and commercialization increasingly centered on cooperatives as the primary supplier of production inputs (seeds and fertilizers) and the primary agent in collective marketing of surplus output. Cooperatives are also expected to play a key role in the provision and management of small-scale irrigation schemes designed to boost both agricultural productivity and marketable surpluses (David J. Spielman and Dawit Kelemework, 2008). The access to irrigation facilities helps smallholders to increase their production and income, creates employment opportunities for the local people, increases the opportunities of smallholder to diversify their income base, and to decrease their vulnerability to drought due to short and erratic rainfall conditions.

Collection Centers: To aggregate the vegetable products of smallholder farmers at a center and to ease product delivery for the buyers' establishment of collection centers have important roles. The study results (table 5) show that among the total respondents, only 9% has availed collection centers (road side) to aggregate and sell vegetables for the buyers. From the sampled irrigation cooperatives, 25% (3) have road side collection centers which were constructed by an NGO. These collection centers were made of corrugated iron sheet and floor made of cement.

But, do not have cold chain system crucial to insure longer shelf life for the vegetables. These centers mainly operated by relatively wealthy cooperative members, to retail and collect products. Most of the time the available collection centers were rented out by the cooperative leaders for individual road side retailers, instead of using the centers for the members' benefit.

Farm Employment: Conceptually, among the many benefits of irrigation, employment generation is crucial, because irrigation farming is labor intensive. Members of irrigation cooperatives shifted from once a year (rain fed) to two or three times production and labor use increased due to irrigation. Most smallholder activities draw from the same family labor sources, because most activities were carried out by human labor. Accordingly, the study result found that 57% (131) of sample respondents were self-employed during dry season, because farmers were engaged in dry season vegetable crops production. This implies that the development of irrigation infrastructure as a result of cooperation has created farm employment opportunities for the farmers in the traditionally slack dry time.

Transportation Service: Most of the farmers transported vegetable products to the local market by donkey cart. Wholesalers and retailers used medium trucks to collect and transport vegetable products from the farm. The survey results show that only 3% of the respondents accessed transportation service through union to transport green beans for the market and this union has 3 medium trucks used to transport vegetable products to the markets, however, inaccessible for the farmers. None of the primary cooperatives have transportation facility to collect and transport vegetable products for the market.

Sales Growth: It is the change in the amount of agricultural products delivered to the market and sold by the farmers due to the membership in irrigation cooperatives. Normally before they became the members of the irrigation cooperatives, after harvesting rain fed crops, they used to be idle during the dry period. However, after they became the members of irrigation cooperatives, they have done irrigation farming during the dry season also. The survey results indicate that 59% of sample farmers observed sales growth i.e an average increased by 23,800 Birr (National currency). Focus group discussion results also confirmed that change in sales growth, which is due to the increase of frequency of vegetable production and increased annual average crop production. Most of the members are self-employed on their own irrigable farm land due to irrigation infrastructure created by irrigation cooperatives.

Crop Diversification: Crop diversification is more essential to minimize the risks from a single crop and to increase the income of the farmers. Farmers of the study area predominantly grow cereals (Maize, Wheat) and some legume such as haricot bean. However, after they were members of irrigation cooperatives in addition to the mentioned crops; all of the sampled members involved in diversified crop production. Due to the existence of irrigation facilities created by the cooperatives they are able to engage in diversified crops such as onion, tomato, kale, green beans, and head cabbage.

Maintenance of Irrigation Pumps: The main triggering factors in the production of vegetables in the area are having irrigation water and motor pump facilities. The main sources of irrigation are lake and ground water.

In both cases farmers use motor pumps (donated by NGOs and Government) through their respective irrigation cooperatives to irrigate their fields. Some better-off farmers and private investors own their own motor pumps. They use irrigation mainly during the dry season. The availability of functional motor pumps assists irrigated vegetable production in the study area. For farmers who rely on engine pumps to lift water for dry season, on time maintenance of failed pumps considerably help to save the vegetable products from damage. In the study area maintenance services were provided for irrigation pumps through different agents. Accordingly, the study results found that 71.3%, 15.7%, 10.4% and 2.6% of maintenance services for pumps were provided through individual mechanics, cooperative members, cooperative union, and primary cooperatives respectively. This shows that the two rural farmer's institutions namely cooperative union and primary irrigation cooperatives have insignificant contribution for the maintenance of pumps. This is one of the critical challenges the irrigation cooperatives and their members faced during course of irrigable vegetable production. Van Dijk et al (2004), stated that the efficiency of a cooperatives strongly depend on member's commitment and loyalty. This member commitment and loyalty is depending on the benefits of the cooperative to its members.

Market Information: The provision of market information is a service that aims to increase the efficiency of agricultural markets and contribute towards overcoming issues of market failure based on asymmetric access to basic market information. In its simplest form, the provision of spot prices aims to assist farmers being able to monitor market conditions and make better decisions on where to sell their produce and negotiate for improved prices rather than being compliant price takers. The fundamental role of market information is therefore to encourage more efficient spatial and temporal arbitrage. While spot information is most useful for direct sales negotiations and to keep abreast of market conditions, the collection of market information over longer term provides trend data that allows farmers and service providers to make decisions on which crops to grow and when to harvest crops based on seasonal price trends (Shaun Ferris, Patrick Engoru, Elly Kaganzi, 2008). In the study area farmers used to select vegetable crops mostly depending on their past farm experience that believed to have better price, good production, individually reached agreement with the buyers and forecasting better market. If they get organized and necessary market information about what to produce, when to produce, and where to sell enable cooperative members to make informed production decision. The study results found that 74.1% and 8% of cooperative members interviewed were accessed market information about demand, price, type and supply of vegetable crops mainly through brokers and traders respectively. The result of focus group discussion and key informant interviews also informed that in the area there is no organized marketing system for vegetable crops, farmers produce and sell vegetables based on their own individual schedule. Also further explained that price fluctuation is high for vegetable products which many times cooperative members become bankrupt, as a result farmers forced to rent out irrigable land and sometimes leave irrigation farming. This implies that cooperatives members produce vegetable crops without knowing the demand in the market. Irrigation cooperatives were made insignificant contribution in search of market conditions and avail market information about demand,

types of vegetables required, price, quality, etc for the members.

Training: According to the cooperative principles, cooperatives need to provide education and training for its members and leaders (ICA, 2015). Training helps farmers to increase their ability to obtain process and use relevant and available resources, technologies, information, etc for their livelihood. Moreover, training creates awareness and provides new skills for the farmers to increase their knowledge and help them to actively participate in different activities. Also improves communication and relationships, creates better team work. As can be seen from table 10, only 22.6% of respondents received training, since they were members of the irrigation cooperatives. The key informants also informed that to improve marketing skills of cooperative leaders, the cooperatives did not organize marketing and other related trainings. Less often Cooperative union organized marketing and other related trainings mainly for management committee, however cooperative leaders neither applied nor equipped skilled on it.

Bargaining Power: It is the negotiating, trading, brokering, etc power members to sell their produce under the umbrella of the cooperatives. Market prices usually appear as an outcome of the price-negotiation process and it is deemed to affect next time production decision. Better prices are also incentives that shift resources towards more commercially-oriented agriculture (G.A Woldie & E.A Nuppenau, 2017). Regarding bargaining power of the cooperative members, the majority (91.7%) of them reported that they have no bargain together. As a result farmers did not get reasonable price for their vegetable products. Cooperatives are considered as one of the most viable approaches to increasing the bargaining power of the scattered and small market surplus producing farmers. However, capital shortage, lack of business skills on the part of the executive committee and lack of business experiences have hampered their successes. As the result of tough competition and unregulated market (high intermediary exploitation) coupled with a lack of bargaining power, smallholders are still at disadvantaged position in the supply chain.

Frequency of Crop Production: The irrigation potential existed in the area and availability of water lifting machines created access for dry season production of vegetable crops, besides rain fed agricultural. As can be seen from Table 11, the majority (73.5%) of members produced once in a year, however, after joining the cooperative, 90% of members started to produce two times in a year. Furthermore, the mean value of crop production before (Mean =1.01) and after (Mean=2.11) cooperative membership also shows a difference which is statistically significant ($t= 43.35, p<0.001$). This implies that as joining in cooperative helps in accessing irrigable land and motor pumps encourage the farmers to increase their frequency of production. The key informants also confirmed that as a result of cooperation, farmers easily access water for irrigation and irrigable land, thus started dry season irrigation farming in addition to rain fed agriculture.

Volume of Crop Production: Vegetables are the main livelihood source in the study area and they produced primarily for the markets. Farmers intensively utilize external inputs for the production of different kinds of vegetables. The productivity and production vary by season, type of seed variety, utilization of the right type and amount of inputs and

agronomic management. But the productivity was very low. Regarding the annual average production, about half (50.4%) of members produced 10-39 quintals of different crops per year before joining the cooperatives. After joining the cooperatives, 37% of members produced 40-69 quintals of different crops per year. The mean value before (Mean= 40.7) and after (Mean= 84.5) membership shows statistically significant difference ($t= 27.37, p< 0.001$). This implies that members improved their annual production after joining the cooperative. The key informant and focus group discussants indicated that this improvement was not because of working together as a cooperative rather they get access to water and land in the name of the cooperatives for their private production.

Change of Income: The additional income gain from irrigated agricultural crops production during the dry season contributes a lot to improve household's livelihood and create access for the farmers to participate on diversified business activities. The survey results show that more than half (53.9%) of cooperative members have annual income of up to 30,000 Birr before the membership from agriculture. After membership, about 37% of members earned 30000-60000 Birr annually from irrigation agriculture. The annual average income of sample members increased from 36,430.00 Birr before membership to 50,297.00 Birr after membership. The results of independent t-test ($t= 24.549, p<0.001$) also revealed that joining irrigation cooperative enables its members to increase their annual average income. The key informant interview also indicated that these increments of income for members of cooperatives was as a result of high value vegetable crops production and using irrigation farmers produced vegetables two to three times yearly, utilization of improved agricultural inputs, increase in production, etc.

Increase in Saving: It is additional amount that is left annually as a result of surplus income gained through production and sale of dry season irrigable high value vegetables since farmers were members of irrigation cooperatives to have saving in their accounts. The results in table 14 shows that sampled members were able to save an average 20,786 Birr which is higher compared to before they were members of irrigation cooperatives. T test results also supported this change of saving amount before and after membership in irrigation cooperatives. The overall contribution of irrigation cooperatives from the above discussion indicates that the sample cooperatives' members have benefitted a lot being as members in different ways especially in terms of change of sales growth, crop diversification, change of volume of production, change of income and saving etc.

Factors Determining the Performance of Irrigation Cooperatives: As mentioned in the methodology, the association between each explanatory variables and dependent variable was conducted by cross-tabulating them. Independent variables were analyzed one by one using *Chi-square* test in order to identify their relation with the dependent variable. For this purpose, 10 relevant explanatory variables such as education, irrigable land size, farm input access; extension service access, additional income, market information, market linkage, members' participation, collective marketing, and union membership were identified through review of literature and tested their relationship with the performance of irrigation cooperatives. In order to examine the relative importance or net effect of each independent variable, multivariate analysis in a form of binary logistic regression was carried out. Before

using the model, multi-collinearity problem among the independent variables was tested using contingency coefficient and it was found that there was no such problem among the variables. The *Chi-square* result ($\chi^2 = 101.52$, $df=10$, $p<0.001$) from the model summary indicates that the overall model is significant when all independent variables are entered. The “pseudo” R^2 estimate indicates that approximately 54.7% of the variance in whether the irrigation cooperatives performance are less or good can be predicted from linear combinations of the ten independent variables. According to binary logistic regression output, out of ten variables which were included in the model, five predictors have found to be significant effect on performance of irrigation cooperatives. Since it has no value to present insignificant variables (educational level, irrigable land size, additional income, market information and union membership) the following few paragraphs describe only significant variables.

Farm input: It is evident that farm input has positive and significant impact on performance of irrigation cooperatives due to the regression coefficient and p-value ($B=1.761$, $p<0.05$) in the model. It can be inferred from the values of odds ratio that if members of irrigation cooperatives use improved farm inputs as recommended such as fertilizer, agrochemicals and improved seed, their cooperatives performance will be expected to increase by 1.761 regardless of other independent variables in the model. In line with this finding, Nurjihan and Amin Mahir (2011) argued that improved farm inputs has great contribution that affects the performance of agricultural cooperatives because good quality and affordable agricultural inputs can support farmers in improving agricultural outputs.

Extension service: It is found that technical support given by extension agents has positive and significant contribution for the performance of irrigation cooperatives ($B= 2.082$, $p<0.001$). The results of odds ratio also showed that availability of extension service increase the performance of irrigation cooperatives by 8.019 units. In support of this finding, Luo and Hu (2015) indicated that extension service has become one of the most important factors for cooperatives to gain competitive advantage and to improve their performance. In addition, Morillo, Martín, Camacho, Díaz and Montesinos (2015) also indicated that irrigation system should be designed with the prevailing wisdom to meet the needs of the production in a timely manner by asking technical support from extension agents.

Market linkage: It is observed from the regression coefficient and p-value that the market linkage has positive and significant effect on performance of irrigation cooperatives ($B=1.746$, $p<0.01$). Those irrigation cooperatives that have market linkage increased their performance by 5.732 units regardless of other independent variables in the model. The results of Verhofstadt and Maertens (2014) also indicated that market linkage is a key vehicle for the performance of agricultural cooperatives improvement.

Member participation: Member participation refers to involving and interference of a cooperatives member in decision making process, plans performing and sharing the interest of development plans, and interfering in the evaluation of plans. The regression coefficient and p-value ($B=2.468$, $p<0.001$) shows that members participation has statistically significant effect on the performance of irrigation cooperatives. The odds ratio shows that members' participation enables their

irrigation cooperative increase its performance by 2.923 units given other variables in the model are held constant. This implied that membership participation increases the performance of irrigation cooperatives. In connection to this finding, Donovan, Blare and Poole (2017) indicated that the performance of cooperatives achieved through members active participation. The cooperative members should have deeper engagement and commitment to support the development process of the cooperative.

Collective marketing: It refers to a number of cooperative members work together to sale their combined crops to their cooperatives. It was expected that there is positive and significant association between collective marketing and the performance of irrigation cooperatives. The model output ($B= 1.265$, $p<0.05$) supports the hypothesis and shows the positive effect and significant association between collective marketing and the performance of irrigation cooperatives. Keeping the influence of other variables constant, a unit increase in collective marketing will increase the performance of irrigation cooperatives by 3.544 units. The findings of Jones and Kalmi (2015) revealed that the performance of a cooperative determined by its member's commitment to sale their products to the cooperatives. They indicated that if large number of cooperative members' sale their products to or through its cooperatives, the cooperative members will have strong bargaining power, get better price, obtain sustainable market for their product and finally have a chance to be developed.

Conclusion

Irrigation cooperatives are common in the rural areas of Ethiopia and the members are assumed to cultivate more than two times in a year and this practice will increase the production and productivity in turn food self sufficiency, income and change the livelihood of members. The study results reveal that most of irrigation cooperatives in the study area have poor performance based on pre-defined organizational and functional performance. However, frequency of production, sales growth, employment, saving, crop diversification and income of the members improved significantly due to the establishment of irrigation cooperatives. While the contribution of irrigation cooperatives in terms of farm input access, market linkage, collective marketing of members' products, setting collection centers, provision of transportation services, provision of extension trainings and others were insignificant. Hence there is an urgent need to address these issues so as to manage the water resources sustainably for the benefit of the farmers. On the basis of the findings following recommendations are made.

- In order to improve the performance of irrigation cooperatives to manage the water resource sustainably, membership has to be voluntary according to the principles of cooperatives. To this effect, farmers have to join cooperatives convinced with the benefits of cooperation, and to achieve common agenda collectively.
- To enable the cooperative members to make informed production decisions and to produce vegetable crops collectively, getting organized market information about what to produce, when to produce, where to sell and market access for their products are crucial factors. To this, all the respective actors need to work together to identify the trend of horticultural market over long

term period. Collective marketing of members' vegetable products can lead to improve bargaining power in negotiation with buyers and intermediaries.

- Before organizing farmers into cooperatives, government and non-governmental organizations need to work together to train the members on the benefit of cooperation, principles and values of cooperatives.
- Government and non-government organizations should give strong support for irrigation cooperatives to improve their contribution in meeting their objectives.
- Government, NGOs, union, primary irrigation cooperatives and members need to work together to identify the trend of horticulture market, and to produce vegetables based on informed production schedule.
- Members are owners, users, and responsible to control irrigation cooperatives. Therefore, relevant stakeholders strongly work together to raise awareness among members on their duties and responsibilities.
- Primary irrigation cooperatives have to be capacitated through provision of technical and financial support and through creating linkage with horticultural farm inputs marketing agencies and research centers which engaged on horticultural seeds multiplication, selling of agrochemicals and vegetable seeds in order to avail the necessary farm inputs for the cooperatives members.

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