Analysis of Off-Season Maize Production in East and West Wellega Zones of Oromiya Region

Research Report No. 37

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Introduction

In the farming systems of West Oromiya Zone, maize is predominantly produced twice a year, in the main-and off-seasons. The off-season maize production has, most probably, been started with the farmers' understanding of their environment and the degree the off-season maize could contribute to the attainment of food security. The possibility of double production of maize by farming communities contributes a lot to policy instruments designed to meet food security.

The main-season maize is produced under rainfed condition, whereas, the off-season maize is produced using residual moisture, locally called 'bonee', and in some places, under small-scale local irrigation scheme. Crop production during dry season in Western Ethiopia covers an area of about 80 000 ha and maize accounts for 65% of all the crops produced (CSA 1996).

To achieve food security for the population, different structural adjustments were made to improve research and development processes. However, until recently, agricultural research and development interventions have been giving emphasis to improvement of the main-season maize production. Although many improved maize varieties have been recommended and released for the main-season, none was attempted for off-season production. The new extension package program has been promoting only the main-season maize production through popularization and demonstration of technologies. But, most crops are harvested in the off-season as well and surplus grain supply may occur in the market. On the contrary, in the main-season, supply may be short and the prices of most crops rise.

Although this needs careful consideration, no study was undertaken to identify and document the major production

constraints of off-season maize production. As a result, area under off-season maize production is relatively small (Table 2).

Past research gave recommendations which did not function in some areas, probably due to differences in farmer circumstances and the environments which the technologies were meant for. No study was made to identify household typologies based on wealth and gender differences. It was thus difficult to spell-out differential recommendations to increase research efficiency and production.

This publication highlights reasons of off-season maize production across household types and production schemes (residual moisture and irrigation) and predicts its potential. Using the recommendations suggested by this study, appropriate policy might be devised to incorporate off-season maize production in research and development endeavors.

The primary objective of maize production in the off-season, both under 'bonee' and 'Jallisee' conditions, is to alleviate food shortages that might occur in rainy season (79.5%), and to lessen cash shortage faced by the family (20.5%). However, inter-household analysis showed that there exists difference in the degree of satisfaction derived from off-season maize production in alleviating food shortages mainly because of wealth difference between households. Farmers reported that poor farm families benefit from the harvests of off-season maize production by fulfilling their food requirement in the rainy season when their grain is depleted from their granary, whereas, the rich ones consider the off-season maize as a supplementary food and cash-generating crop.

Despite this difference in the degree of satisfaction, rich farmers produce it on large hectares compared to the poor ones. Rich households consider the cash that could be generated from the sale of grain or green cobs and also the satisfaction that could be derived from the luxurious consumption of the green cobs. But, poor households consider the amount of satisfaction that

could be obtained from the consumption of green cobs as main food. Considering inter-crop production in the off-season, land allocation has been the function of productivity, time, value of food, availability, suitability of bottomland for bonee, and availability of irrigation water.

The Study Area

The Oromiya National Regional State has 12 zones of which West Wellega and East Wellega are the two. West Wellega is characterized by rugged topography, ample water and forest (coffee and trees) resources, and a number of religion-and development-oriented institutions. It is bordered by Sudan to the West; Benishangul-Gumuz National Regional State to the Northwest and Northeast; Gambela Peoples National Regional State and Ilubabor Zone to the Southeast; and East Wellega Zone to the East. It has a total area of 2 398 000 ha out of which 31% is under cultivation, 23 % is potentially cultivable, and the rest is covered by mountains, forests, bushes, hills, termite infested mounds and constructions (Planning Section of West Wellega Bureau of Agriculture 1994).

According to the Oromiya Bureau of Agriculture, the population of the zone in 1999 was 1 804 196 of which 891 921 were males and 912 275 females. The rural population was 1 634 125, the rest being urban dwellers.

The annual rainfall ranges from 800 to 2000 mm. The zone has annual temperature of between 17.5 and 27.5 °c. It also has five main soil types; namely, orthic Acrisols, mumbic Cambisols, eutric Fluvisols, Nitosoles and chromic Vertisols (Planning Section of West Wellega Bureau of Agriculture 1994).

Similarly, East Wellega Zone is known for its rugged topography, forests, water resources, and mixed farming systems.

It has highland, midland, and lowland physiographics and suitable climate for growing crops and for rearing different animals. Especially in the mid-altitude, two production seasons have been followed for maize: the main- and the off-seasons.

Out of the total cultivated land, bonee maize farming covered 4441 ha compared to irrigation-based maize farming which covered 4632 ha (Planning Section of East Wellega Bureau of Agriculture 1999). The total population was 1 452 568 out of which 713 313 are males and 739 215 females. The zone has covered a total land area of 2 186 382 ha (Ibid).

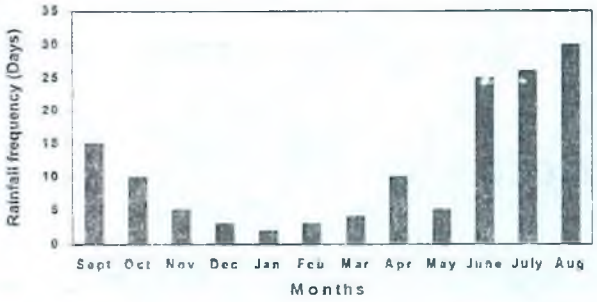
The land has been allocated for different purposes (Table 1). Annual rainfall ranges from 800 mm to 2433 mm with varying frequencies across months (Fig.1), whereas, temperature ranges from 4.4 to 38°c. The major soil types known in the area include: Nitosols, Vertisols, Alluvials, and gray soils (Ibid).

Table 1. Land types and coverage in East Wellega Zone

Land type	Cultivated	Potentially cultivable	Forest	Pasture	Irrigable	Bonee	Others
Coverage (ha)	955 796.8	362 877.2	184 362.7	267 862.5	7523.4	4441.0	298 808.8

Source: Planning Section of East Wellega Bureau of Agriculture 1999

Figure 1. Rainfall calendars of the study areas



Source: PRA (Unpublished)

Land size allocated to off-season maize varies across districts of West Wellega and East Wellega Zones (Table 2).

Table 2. Area under off-season maize production in 2000 by district in the two zones

West Wellaga			East Wellaga		
District	Area under Bonee (ha)	Area under irrigation (ha)	District	Area under Bonee (ha)	Area Under irrigation (ha)
Manasibu	8111.0	36.0	Diga-Leka	583.0	599.0
Nole-Kaba	2071.0	68.0	Jima-Arjo	250.0	495.0
Haru	1470.0	-	Nunu-Kumba	247.0	66.0
A/Guliso	2451.0	-	Amuru-Jarte	228 0	102.0
Yubdo	1099.0	-	Guto-Wayu	650.0	998.0
D/Lalo	493.0	19.0	Sibu-Sire	102.0	703.0
Gawo Dalle	9.0	-	Bila-Sayo	432.0	306.2
Hawawalal	3.0	2.5	Limu	935.0	277.0
Sayyo	4.5	5.0	Ibantu	410.0	97 0
Anfillo	10.0	2.5	Abe-Dongoro	250.0	100.0
Bojji	2087.0	-	Sasiga	104.0	304.0
Nadjo	2182.0	90.0	Gida-Kiramu	250.0	81.0
Beggi	131.0	-	Jima Horo	-	245.0
Jimma G.	13.0	1.0	Abay-Choman	-	17.0
Gimbi	3453.0	-	Jima Rare	-	241.8
Lalo Asab	1558.0	-	-	-	-
Jarso	1126.0	-	-	-	-
Total	26271.5	224.0	Total	4441.0	4632.0

Source: Planning Section of East Wellega and West Wellega Bureaus of Agriculture, 1999

Methodology

Development-oriented research approach (DORA) was adopted to implement this project by a multidisciplinary team. The team made a survey across two principal off-season maize producing

zones, West and East Wellega by selecting one site from each, one for irrigation and the other for residual moisture, along with development experts and agents in respective sites.

In East Wellega, off-season maize production has been practised largely under irrigation and was selected to investigate patterns and constraints of production across household types. West Wellega farmers largely use residual moisture for off-season maize production, but traditional and improved irrigation schemes are less practised. For that reason, one location was selected to investigate production and productivity of off-season maize production under residual moisture condition across farmer types. The survey passed through the following three phases.

Phase I: Qualitative Data Collection

Farmers were grouped into six to eight members, considering age and gender composition, to collect group responses to the questions. The team monitored homogeneity of the responses among groups. Once the team was through with the semi-structured interview (SSI) with the groups, other suitable PRA tools such as seasonal calendars of crop, labor, rain, and price; timeliness (trend analysis); wealth ranking; and problem ranking were used to supplement data of seasonal sensitivity, time sensitivity, and priority seeking. The purpose was to see how much the farmers realize changes in their farming systems and visualize the circumstances.

Phase II: Verification of Qualitative Data

In this phase, the team collected qualitative data from individuals and key informants using SSI and other PRA tools assumed to be

very important. The tools were wealth ranking, problem ranking, seasonal calendars and timeliness. The whole questions in the checklist were administered to the groups and repeated to individuals and key informants to identify data gap.

Phase III: Quantitative Data Collection

In finalizing field data collection, the team collected quantitative data using focused formal survey (FFS), and then administered structured questionnaire to target farmers to add to the accuracy of the responses. Quota sampling technique was used because homogeneity was assumed within the locations selected during the survey. Sixty farmers (30 from each location) were taken from 'Wali-Galte Agar' of West Wellega and 'Warra-Babbo' of East Wellega—locations which were selected for investigation of off-season maize production under residual moisture (bonee) and irrigation schemes, respectively.

Method of Data Analysis

Qualitative data were analyzed using DORA tools like concepts and principles, tree forms, task analyses and problem ranking; whereas SPSS was employed for processing frequencies, cross-tabulation, and mean comparison of quantitative responses.

Results and Discussion

Zonation, Household Typologies and Field Types

Zonation

Prior to embarking on field data collection, the team and the agricultural experts of the districts identified two principal zones based on the objective of the study and the scheme of production. Zone I solely emphasized on off-season maize production under residual moisture and Zone II on off-season maize production under irrigation. West Wellega for Zone I, and East Wellega for Zone II were selected to conduct this project.

Household typologies

The logic behind the need for developing household typologies was to help improve research work in delineating recommendations and in developing client-oriented technologies which can easily be taken up by users. The team identified the farmers into three groups based on their wealth (Table 3).

Table 3. Wealth ranking of West and East Wellega farmers using ranking criteria set by them

Criteria	Types of household					
	Poor		Medium		Rich	
	East Wellega	West Wellega	East Wellega	West Wellega	East Wellega	West Wellega
Percentage	30	30-40	60	50	10	10
Oxen no.	0-1	0-1	2	2-4	6-8	6
Land holding (ha)	0-2	1-2	2-3	2	5	4
Cattle no.	0-5	-	10-15	5-10	40	30-50
Coffee (ha)	-	-	0-0.5	1	1-2	2

Source: PRA (Unpublished)

Resource-poor households: Thirty percent of the farming community fall under this category. This group is always suffering from food and cash shortages. Local employment opportunity is expected from relatively rich farm households, the earning of which is used to meet their immediate household needs. The primary goal of this type of households is to fulfill their family food security. Ability rather than availability seems to influence their participation in the new extension program for the main season.

Medium households: About 60% of this major group share the problems and necessities of the resource-poor households. But cash shortage is more important than food shortage. The well-to-do farmers in this group can participate in extension package programs even though accessibility to roads could affect the degree of their participation.

Rich households: Relatively adequate resource is available to the family of this group. They cover about 10% of the farming community. They produce surplus but are constrained by market and road infrastructure in supplying it to food deficit areas. They are participating in extension package programs at large but are constrained by absence of adequate inputs. Availability rather than capability might influence their participation in the extension package.

Field types

Identifying the type of fields owned by farm households is important to explore information about input requirement by amount and type, crop type to grow, and gender sensitive issues. The team found out that five field types were common in the study areas (Table 4). Of these field types, three were common in each study area. In Zone I (West Wellega); homestead, common

field, and bonee field, and in Zone Π (East Wellega): homestead, common field, and irrigable field were common.

Table 4. Field types commonly owned by households in the study areas

Field type	Crop	Soil color		Soil workability		Soil fertility	
		East Wellega	West Wellega	East Wellega	West Wellega	East Wellega	West Wellega
Home-stead	Maize, sorghum, yam	Red-brown	Brown	1	2	3	2
Common	Finger millet, tef, noug	Red	Red	3	3	4	4
Bonee	Maize, potato, haricot bean, taro	Brown	Brown	4	1	1	1
Coffee /forest	Coffee, banana, and mango	Red	Brown	5	4	2	3
Irrigable	Maize, potato, onion	Red	-	2	-	2	-

Source: PRA (Unpublished)

Homestead field: as this field is around the home, women manage it at large in addition to their household activities. Maize and sorghum are common crops grown on this field type in order of importance. It is relatively fertile due to the daily drop of household refuses and the application of manure. It is reddish brown.

Common field: This field is the focal point of research in order to supply soils with appropriate nutrient for soil fertility replenishment to increase yield. But, no research has been attempted on other field types until recently. Common crops grown on this field type include finger millet, tef, and noug. It is less workable because of declining fertility of the soil caused by continuous cultivation and erosion.

Bonee field: This field type is located in bottomlands alongside rivers and their tributaries. Maize, potato, haricot bean and taro are the major crops known and grown in the off-season under bonee (residual moisture). The soil is a kind of alluvial formed as a result of watershed, and is black to gray.

Irrigable field: Irrigable field is located where traditional, improved or both schemes are available either around homestead or in distant areas. The crops grown by small-scale farmers on this field type include maize, onion, potato and other horticultural crops adaptive to that specific agroecology.

In general, bonee field under residual moisture and homestead and common fields under irrigation and rainfed conditions are suitable for off-season maize production.

Household Features and Socio-Cultural Roles

Family size and household heads

Results of PRA made in April 2000 revealed that in the farming communities surveyed, a minimum of three and a maximum of fifteen family members, a large proportion of whom being children, are dominant in both Zones. Analysis of the quantitative data collected using focused formal survey showed that an average family size was eight in East Wellega, and seven in West Wellega. Dependent family members were computed to be three and five, respectively. The average working family members were found to be four in both Zones. No significant differences were observed ($P>0.1$) in socioeconomic and demographic characteristics (Table 5).

PRA tool was used to investigate the patterns of who is heading the household; and both female-and male-headed households were identified. Death of husbands was the primary

reason for the presence of female-headed households. Focused formal survey revealed that 98.4% of the farmers interviewed were male-headed households, and the rest 1.6% of them were female–headed. Older farm families dominate because the young migrate to urban areas in search of employment or education.

Table 5. Socioeconomic and demographic characteristics of Warra-Babo and Waligalte-Agar

Variables	Locations		Probability levels
	Warra-Babo of East Wellega Zone (n=31)	Waligalte-Agar of West Wellega (n=30)	
Family size (no.)	8.00	7.00	0.101NS
Farm size (ha)	2.55	1.73	0.001**
Arable land (ha)	2.24	1.68	0.002**
Bonee land (ha)	0.33	0.48	0.779NS
Irrigable (ha)	0.31	0.00	--
Coffee and cereals (ha)	1.60	1.20	0.032*
Pasture land (ha)	0.31	0.05	0.000**
Farming experience	31.00	31.00	0.949NS
Cattle (no.)	6.00	4.00	0.003**
Oxen (no.)	2.00	0.83	0.000**
Sheep (no.)	0.60	0.20	0.145Ns
Goat (no.)	0.10	0.33	0.218Ns
Chicken	1.20	1.20	0.991Ns

Source: PRA (Unpublished)
Note: * and ** show significance of t-statistics at 5%and 1%probabilities, respectively.
NS= statistically not significant (t-stat) at 5%probability.

Education, training and farming experiences

Farmers' perceptions towards technologies in use and their future strive to innovate and participate in research were analyzed. The analysis revealed that a large proportion of the interviewed household heads had secondary education (49.4%) followed by illiterates and those who attended elementary education (Table 6). Inter-zonal analysis also indicated that greater percentage of farmers producing bonee maize (11.5%) attended adult education

in the early Dergue regime compared to those producing maize (4.9%) with irrigation. Likewise, the extension education rendered by the respective agricultural development offices was the single most important deductive source for farmers. Homogeneity was observed between the farming experiences of the two locations (P>0.1).

Table 6. Education level of sample farmers by location

Level of education	Respondent farmers (%)		Total (%)
	West Wellega	East Wellega	100.0
Illiterate	18.0	14.0	32.0
Adult edu.	11.5	4.9	16.4
Elementary	13.1	13.1	26.2
Secondary	33.3	16.1	49.4

Source: PRA (Unpublished)
NB N=30 for East Wellega: and 31 for West Wellega Zones

Farm size

The size of landholding has been one of the indicators of wealth status within the communities surveyed. Independent sample T-Test revealed that there was significant difference in the average size of farmland owned by farmers of Warra-Babbo and those of Waligalte-Agar (P<0.05). The mean sizes of farmlands owned by a household were 2.6 and 1.6 ha for Warra-Babo and Waligalte-Agar, respectively (Table 5). Land allocation to off-season maize production depends on the scheme of production: production under residual moisture or under irrigation. Farmers in West Wellega Zone allocate relatively larger fields to bonee because the crop is early maturing and helps them alleviate food shortages. The nature of the field allocated also matters. Bottomland, which is not suitable for cultivation in the main season because of its marshy nature, is allocated to bonee.

On the other hand, farmers in East Wellega Zone produce off-season maize under irrigation largely weighing the potential of

maize in meeting their time-bound food shortage problems and in utilizing the available irrigation water.

Food habits

Traditional food items used for daily consumption by the native Oromos and other new settlers are locally called 'Buddeenaa' (made from millet and sorghum)—maize buddeenaa being number one. Others like 'Chumboo' (made from maize, tef or wheat), 'Buna-Kalaa' (made from coffee and butter), 'Kochoo' (made from yam) and 'Qorii' (made from barley and butter) are consumed on holidays and in occasions when guests are invited. These are common in the two zones.

Gender roles in resource control

Household resources were divided into two broad categories: farm resources and house utensils. Husbands largely control farm resources and wives control house utensils. In both cases, there were common resources utilized by both gender groups to facilitate operation. Female have control of some farm resources because some operations "concern only them". Generally, men play the largest role in decision making regarding valuable resources, whereas women decide on less valuable ones without the intervention of men. Farmers were asked for the effect of these gender differences on their productivity and they responded that no influence was noted. Responses from key informants, however, revealed that misuse of household property, family dispute, and household economic crises are the major gender influences observed in the study area.

Maize Production

Maize as a principal food crop of the people in the mid-altitude areas is grown in two seasons: main season and off-season. Cross tabulation analysis showed that of the farmers interviewed in the two zones, 54.1 and 45.9% have been producing maize under bonee and Jallisii, respectively. Among the producers of maize under these conditions, 91 and 9% were from West Wellega and East Wellega Zones, respectively. All farmers sampled from East Wellega Zone were those producing maize under Jallisii and none was interviewed from West Wellega Zone.

Traditional agronomic practices

Land preparation: Since the introduction of off-season maize production, land preparation has been practised to create environments conducive for germination of seed. Males do this. It has many activities such as site selection, land clearing and plowing. Land clearing is done before December, most likely starting in November. Plowing starts in December and ends in January. Three to four times plowing before planting is common as reported by the farmers. There is also a possibility of overlapping operations for off-season maize production in different plots, for instance, plowing and planting. Both broadcasting and row planting methods are followed. In row planting, the spacing between plants and rows has not yet been determined. Two fold of the recommended seed rate (50kg ha^{-1}) has been used for off-season maize subjected to thinning.

Weeding: Women and children perform weeding at large. Also men do it to some extent. Weeding of bonee maize starts in February and ends in March. The major weed species known in off-season maize field include 'Dinnicha boyye', 'keelloo', and 'qamaxxee' in local language ('Afaan Oromoo'). Hand weeding

(three times), hoeing using hoe (one time), and slashing using sickle (two times) have been common weeding practices in the area.

Fertilizer application: Use of chemical fertilizers is not common in off-season maize production under residual moisture condition (100%). But, about 86.7% of the farmers producing maize under irrigation use fertilizer although they use them at lower rates due to increasing prices of fertilizers. Some farmers practise spot application of manure especially in irrigation maize fields to cope with the increasing costs of chemical fertilizers on the one hand, and declining fertility of the soil on the other.

Harvesting: Two types of off-season maize harvesting have been common at different stages of the crop: green cob and matured cob grain harvesting, depending on the household typology. Green cob harvesting starts in June both for the poor and the rich farmers even though the poor may start early. Grain harvesting starts in July and ends in August. However, this doesn't involve poor households because they, in most cases, totally consume their produce at green cob stage.

Yield potential of off-season maize

Yield assessments were made clustering off-season maize production into two production schemes: under residual moisture and under irrigation over two extreme weather conditions of bad and good. Analysis of data revealed that highly significant yield difference ($P<0.05$) was observed between off-season maize production under residual moisture (14 q ha^{-1}: 4 q ha^{-1}) and under irrigation (8 q ha^{-1}: 2 q ha^{-1}) in good and bad weather conditions, respectively. Irrigation maize yield is very low due to unavailability of improved varieties and planting on sloppy lands prone to erosion.

Constraints in off-season maize production

Off-season maize production constraints prioritized by the farming communities include stalk borer, cutworm, lodging, lateness, and frost attack (not frequently). On the other hand, inter-household analyses indicated that oxen and land shortages were the priority problems for the poor.

To minimize the infestation of stalk borer, farmers have been removing and burning crop residues from the maize field. Cutworm is locally controlled by hoeing and frequent watering to create disturbance, as it is sever when water is deficient.

The team, the farmers and agricultural experts pertinent to off-season maize production at respective sites made problem-ranking exercises using matrix-ranking procedures, ranked the constraints (Table 7) and identified their intricacies (Fig. 2).

Table 7. Problem ranking as made by the team, the off-season maize producers and agricultural experts in the areas

Constraint	Rank	
	East Wellega	West Wellega
Cut worm	1	2
Termite	3	4
Stalk borer	2	1
Lack of improved variety	4	3
Birds	5	5
Hail	6	6
Frost	7	7

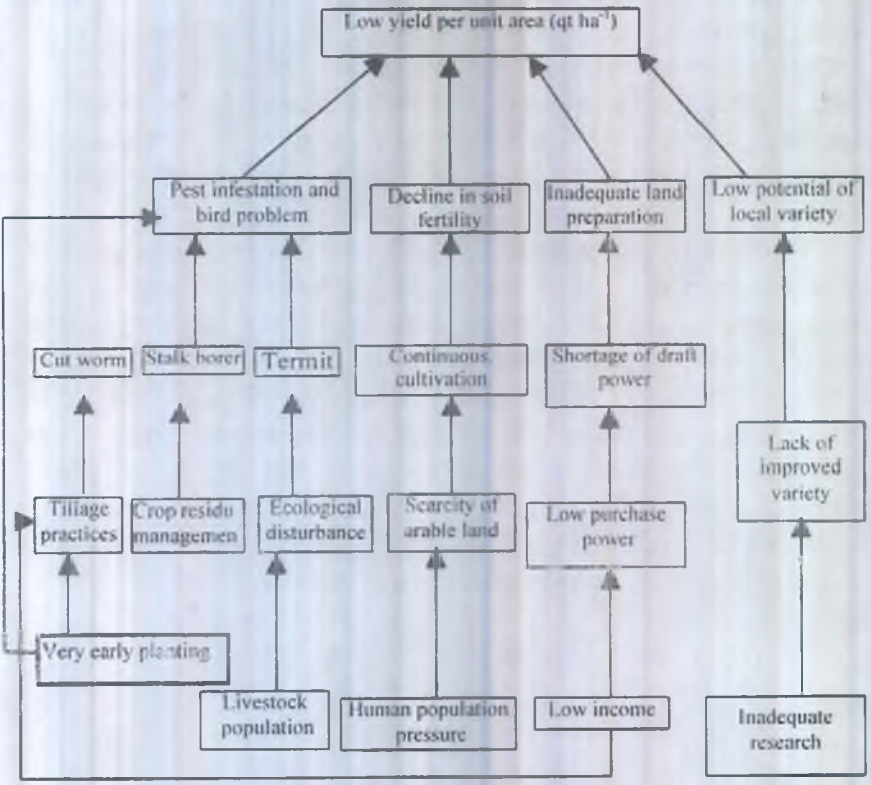
Source: PRA (Unpublished)

Insect pests: It was realized that cutworm, termite, and stalk borer are among the most important insect pests affecting the production and productivity of off-season maize under residual moisture condition (Table 8). Earworm and birds were also important constraints. The causes of the occurrences of these insects were reported to be monocropping of maize, left over of crop residues, and poor weed control. Overlapping of off-season

maize production with the natural build up of insect population is the other most important cause. Birds were also identified to attack off-season maize because of the greenish area covered by off-season maize planted out of season and serving as the only feed supply for birds during the season. Termite is the second important insect pest in West Wellega. The trend seems that its importance is increasing with years and so does its severity. It has dual importance as reported, directly by damaging the crop, and indirectly by causing soil fertility decline through damaging the vegetation cover of the area and thereby exposing the land to erosion.

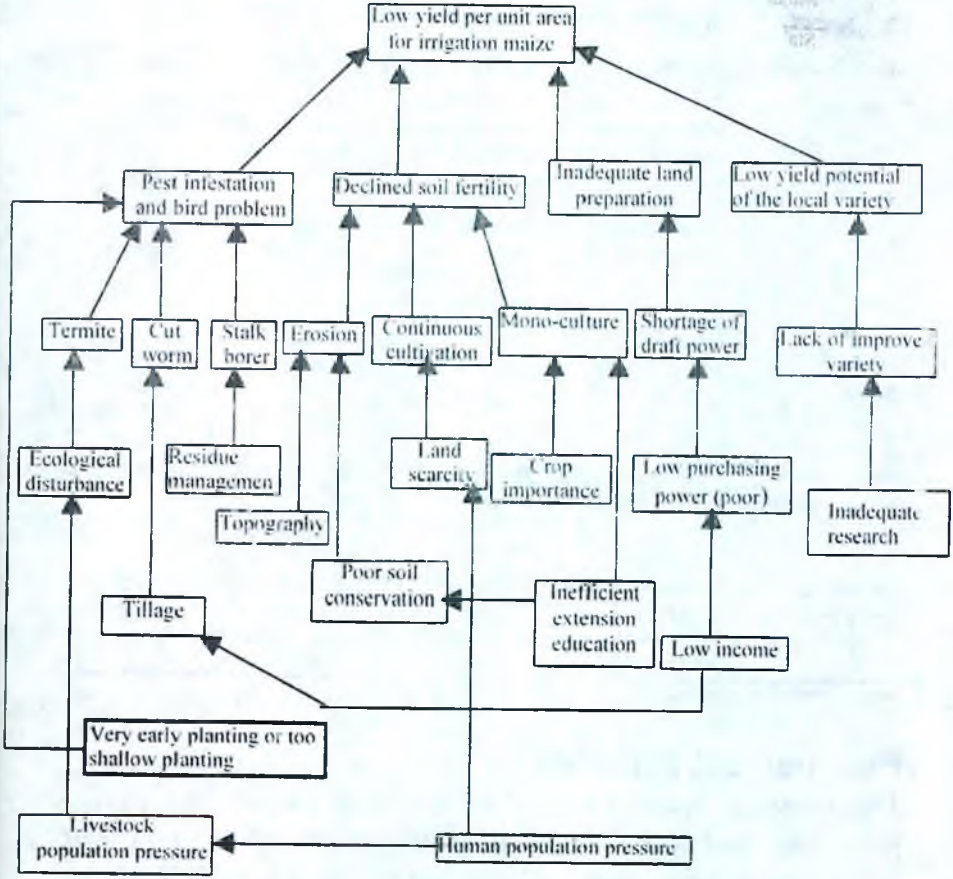
Problem tree in both Zones indicated that low yield per unit area has been the core issue of the farming communities. Pest infestation, soil fertility decline, inadequate land preparation, and use of local varieties were found to be the immediate causes of low productivity of maize in the off-season (Figs. 2 and 3). In maize production under bonee condition, soil fertility decline was not a serious problem for all growers but for those where watershed was minimal. On the other hand, under irrigation-based maize production, soil fertility decline was emphasized to be the major cause of low productivity recorded so far.

Figure 2. Problem tree for bonee maize production in West Wellega



Source: PRA (Unpublished)

Figure 3. Problem tree for irrigation-based maize farming in East Wellega



Source: PRA (Unpublished)

Table 8. Major pests of off-season maize, their infestation, frequency of attack, symptoms and indigenous control measures

Variables	Major pests in order of importance as indicated in parenthesis			
	Stalk borer (1st)	Cut worm (2nd)	Ear worm (3rd)	Birds (4th) - "Arraagessa"
Infestation (%)	20-60	10-40	5-10	0-90
Attack frequency	Regular	Regular	Regular	Occasional
Symptoms	Cut through maize whorl and form 'dead heart' plant; rows of short holes on the leaves of young plants; stalk tunneling	Cut off the plant at the bottom edge causing it to wilt even when soil moisture is adequate; cut worms are seen when digging the soil beneath the plant	Kernels of the maize are eaten down to the bottom cob starting from the ear-top; attacked ears show moist casting at the end	Seedlings in some or all parts of the field become bare
Crop Parts attacked	Leafs, stalk, in rare cases tassel	Roots, stems	Maize ears	Germinating seeds or emerging seedlings, ear
Traditional control measures	Rouging out the infested plants	Hoeing, Hand picking or collecting and killing	--	Guarding and use of bird scarer
Problems of control measures	Farmers could not afford the prices of chemical pesticides	Unavailability of low cost chemicals for seed dressing	Farmers could not afford to buy chemical pesticides	--Time consuming

Source: PRA (Unpublished)

Post-harvest activities

Indigenous management of storage pests: The storage pests identified to be important in off-season maize grain were very similar with those of the main season. But, there are differences in pre-harvest pests. There are major insect pests known to affect off-season maize during storage, and there also exist indigenous management practices for these pests (Table 9).

Table 9. Major storage pests and their control in off-season maize production

Pest	Rank for loss		Traditional control measures
	E. Wellega	W. Wellega	
Rodents	1	2	Traps, cat rearing
Weevil	2	1	Hanging over smoke, sun drying
Fungus	3	3	Storing in well aerated place and sufficient drying
Termite	4	4	Hanging maize cobs above fire places; storage in termite–proof storage

Source: PRA (Unpublished)

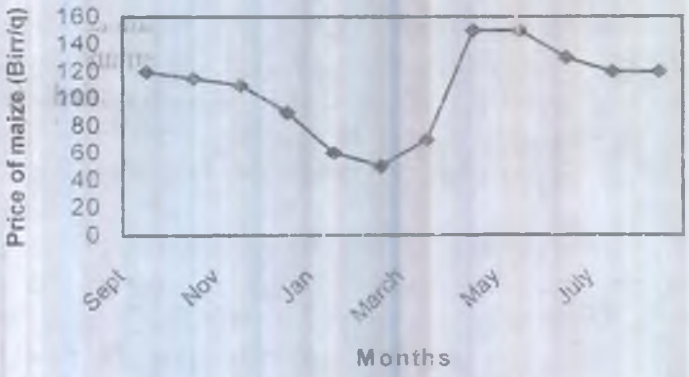
Marketing: Two market types are dominant in maize (whether off-season or main season) marketing system: small and relatively big. In the small markets, except live animals and other important agricultural and industrial products demanded by different age and sex groups, produces are supplied for transactions. In big markets, all necessities for human well–being are supplied.

Major crops supplied to markets irrespective of their prices were coffee, maize, millets, tef, sorghum, noug and rapeseed. Two pricing systems have been practised for long time. In normal markets, demand and supply forces determine the equilibrium prices of products. Surplus demand or supply shortages force the price to rise and vice-versa—attracting buyers and sellers to act accordingly. Hence, both buyers and sellers are price makers whereby one has no power to influence the price. However, in the case of local traders (whole buyers), buyers are price makers and sellers are price takers. Local whole buyers set their price per kilogram based on the situations of their customers (farmers and others) and price of the same product in the destination market place. The most favorable situations for local whole buyers to monopolize price-making prevail during tax collection, and loan repayments when "*farmers have no tongue to challenge*".

Price fluctuation; the function of many factors like supply, holidays, periods of tax collection and loan repayments; is

another factor affecting the farming community. Maize is surplus from November to March, as it is the time of harvesting. During this period, almost all producers supply grain to the market and low demand is available forcing the equilibrium price to fall. However, April to June is a food deficit period when not only non-farming communities but also farmers themselves demand grain for their family consumption. Thus, this repurchase of grain by farmers contributes to increases in maize prices (Fig. 4).

Figure 4. Monthly price of maize in the study areas



Source: PRA (Unpublished)

The principal buyers of maize grain in order of importance were consumers retailers and local whole buyers. Because there is a declining trend in price from December to February and increasing trend from March to June, all buyers except consumers buy maize grain in low price period to sale it during high price periods. The period from June to September is known for green cob and grain consumption of bonee maize, price is neither increasing nor decreasing in the producing areas during these months.

Soil Fertility Management

Use of organic fertilizers

The effect of watershed such as transporting fertile soil to the bonee field has been the means of soil fertility amendment for off-season maize production under residual moisture condition. But, no other organic and/or inorganic fertilizers have been applied. In soil fertility maintenance under irrigation-based off-season maize production, however, as the field type determines the use of inputs, organic fertilizers like manure and household refuses have been applied in homestead fields using manure transfer and kraal rotation methods. Whereas, in common fields chemical fertilizers have been used.

In irrigation–based maize farming, sometimes homestead fields have been allocated to off-season production provided that irrigable water is available. In such situations, manure and household refuses have been used to maintain soil fertility. The common methods used in manure application were transferring the manure using human labor, especially that of women, and rotation of kraal over the maize field by males. The field supplied with manure can stay fertile up to three or four years giving high yield, as reported by farmers.

Cropping systems

Traditional cropping systems have been used to maintain soil fertility. The major cropping systems are crop rotation and fallowing, double cropping, intercropping, relay cropping and residue management (Table 10). Farmers reported that rotation of maize with other crops has been the common practice when soil productivity tends to decline (potato – maize; onion–maize; etc). Present fallowing, compared to those of the other years, has been declining due to shortage of suitable irrigable fields caused by population pressure. Double cropping has also been a usual

practice for dual purposes: to sustain family life and to ameliorate soil fertility. Bonus harvest from the associate crops in intercropping was common. Participants also revealed that crop residue management (removal or leaving on the field) has been the practice used for longer periods in view of attaining fertility of soils for off–season maize production.

Table10.Cropping systems practised for soil fertility management

Cropping systems	Percentage of bonee producers (n=31; 50.8%)		Percentage of farmers producing Jallisii maize (n=30; 49.2%)	
	Yes	No	Yes	No
Crop rotation	0.0	90.9	17.9	82.1
Fallowing	18.8	75.0	3.6	96.4
Intercropping	31.1	18.0	19.7	31.1
Double-cropping	1.7	48.3	21.7	28.3
Relay cropping	1.6	47.5	0.0	50.8
Crop residue	36.4	54.5	6.1	3.0

Source: PRA (Unpublished)

Chemical fertilizers

Under off-season maize production, the use of chemical fertilizers in boosting the productivity of maize is less feasible mainly because of the scheme of production and the field type allocation. There are two principal schemes of maize production (under residual moisture and irrigation) in the study areas.

Regarding soil productivity, the fertility ranking made by farmers for field types revealed that bonee field was the most fertile farmland next to homesteads. Homestead field is most fertile for it is provided with organic fertilizers daily and the bonee field is fertile due to the replenishment of the topsoil transported from the hilltops through watershed to the bonee site.

Under bonee the use of chemical fertilizers may not be economical. Testing the yield potential of improved varieties under existing soil condition will be essential. However,

investigation of the fertility of the soil could be an important research area. On the other hand, the use of manure on homesteads will be a viable option for maize production under irrigation. Availability of adequate irrigation water for the common field may also restrict large-scale production of maize in the off-season using inorganic fertilizers. In this regard, therefore, changing the system of farming from inorganic to integrated (union of organic and inorganic) will be sensible in future research and development endeavors.

Conclusions and Recommendations

Biannual maize production (in off-season and the main season) is a common practice in West and East Wellega Zones. The farming communities use off-season maize as a strategy to alleviate seasonal food shortages. Policy makers should consider this strategy in designing policies related to food security. Effective research intervention should address site and target specific technologies, which could result in boosting the production and productivity of maize.

- Maize research should generate improved varieties and management practices which: easily fit in the system, are economically affordable and socially acceptable, and help attain sustainable production and productivity of off-season maize and conservation of economically and agro-ecologically important resources. In this regard, the client–oriented research approach appears to be most feasible.
- Research should be undertaken on the use of organic fertilizers and their economical use in integration with inorganic ones.

- Improvement of the rural road and market infrastructures and information systems should be facilitated. To this end, the contribution of non-governmental organizations and investors should be appreciated and harmonized.
- Consideration of farmer typologies in research and development processes positively contributes to sustainable and equitable allocation of resources and acceptance of technologies. Thus, it should be strengthened.
- The potential of off-season maize production should be seriously considered in the promotion of irrigation and its related technologies.
- Prevention and control of pests and diseases should be designed for off-season maize production.

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