

Impact of Winter Chickpea Technology in Syria



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Seminar Structure

- Introduction
- Chickpea production status in Syria
- Recommended winter chickpea package in Syria
- Dissemination of winter chickpea
- Objectives and methodology
- Characterization of household assets and wealth index
- Farmers' perception on winter chickpea
- Adoption and diffusion of winter chickpea
- Impact on productivity
- Impact on profitability
- Impact on household income
- Impact on labors
- Water productivity
- Conclusion and recommendations



Introduction

- In Syria, chickpea (*Cicer arietinum* L) traditionally is sown during spring on conserved soil moisture and its productivity is constrained mainly due to terminal drought and vascular wilt.
- The farmers plant chickpea in spring if sufficient rainfall has taken place during winter months to ensure successful spring planting.

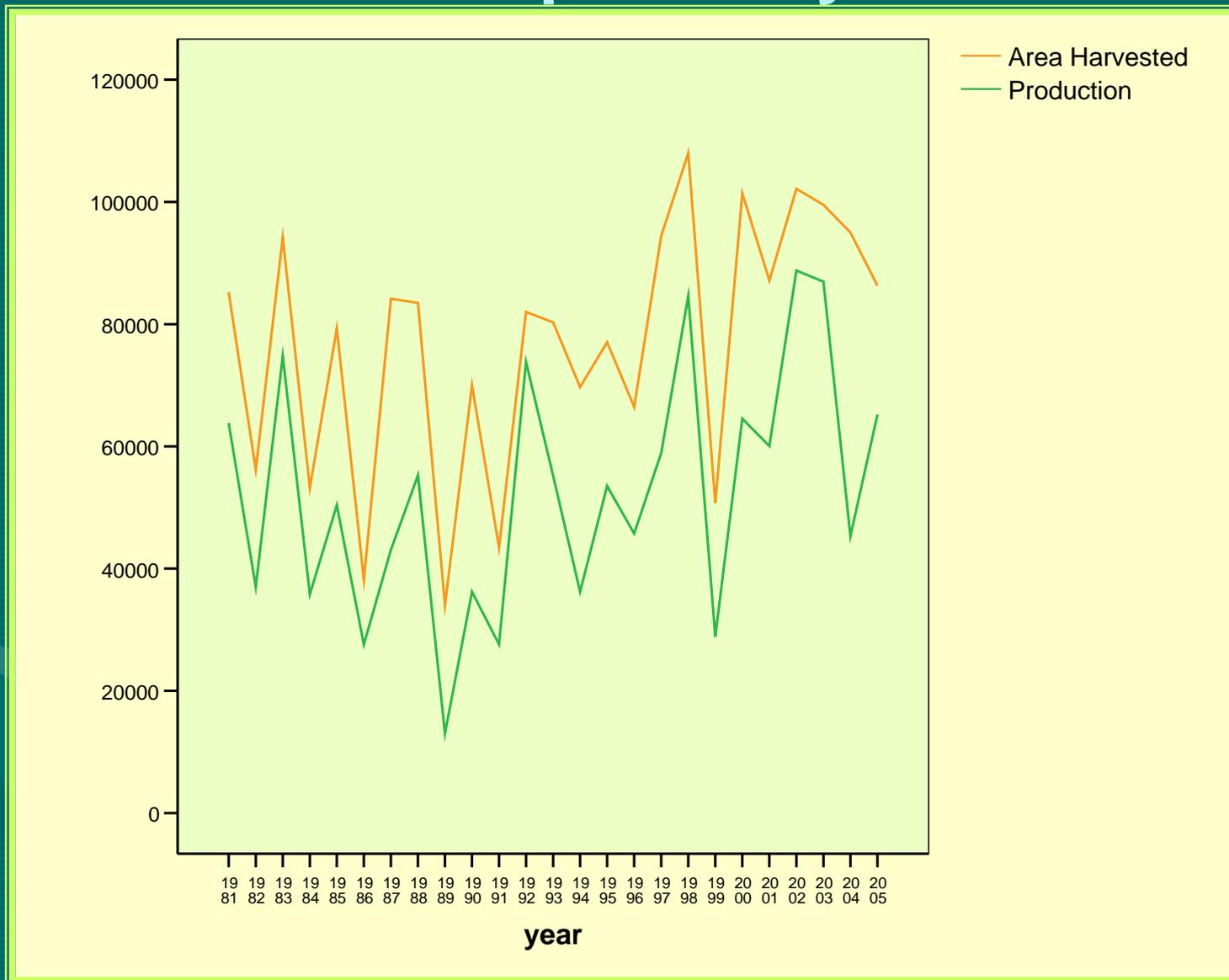


- **Since pressure on land is increasing, the economic benefit can get from spring chickpea is declining relative to other crops in the farming system, therefore, the area and production was not stable**
- **Winter-sown chickpea promises to solve many problems through**
 - **Ascochyta blight resistance**
 - **Higher yield potential**
 - **More productive use of land**
 - **Serve to stabilize chickpea area, and**
 - **Sustain the farming system**

Chickpea Production Status in Syria



Area and Production of Rainfed Chickpea in Syria



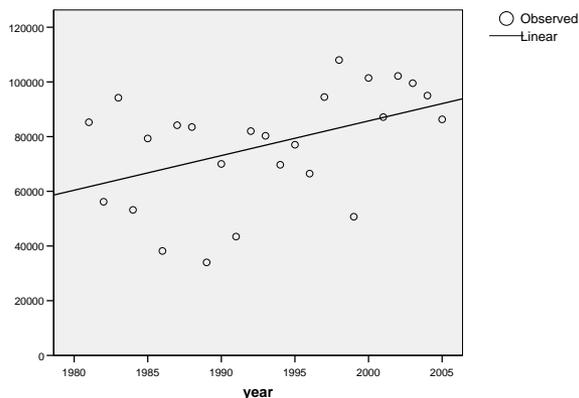


Area, Yield, and Production of Chickpea in Syria during (1981 – 2005)

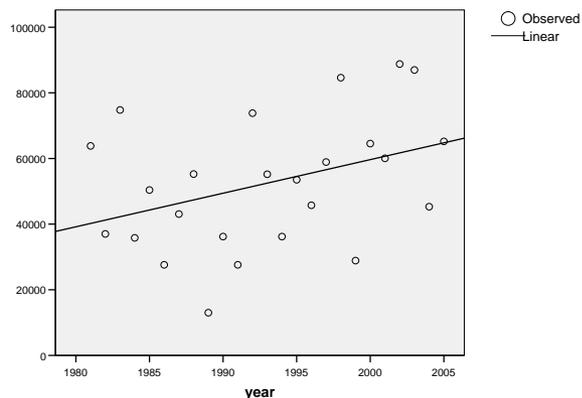
	Minimum	Maximum	Mean	Std. Deviation	C.V%
Area Harvested (ha)	34000	108012	76865	20821	27
Yield (Kg/ha)	382	900	668	127	19
Production (MT)	13000	88781	52488	20035	38

Estimated the Annual Increase of Chickpea Production, Area, and Yield

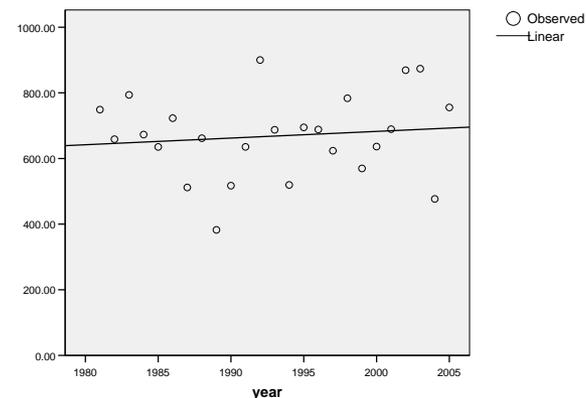
Area Harvested



Chick peas production in Syria (1981 -2005)



yield



	a	b	R Square	Model Sig.	% annual increase
Production	-1987268	1023.46	0.141	0.064	1.606
Area	-2448017	1266.88	0.201	0.025	1.395
Yield	-3382.52	2.03	0.014	0.575	0.294



Recommended Winter Chickpea Package Components in Syria

- **The Main Components:**
 - Improved varieties: Ghab 3, Ghab 4, Ghab 5
 - Seed rate: 120 Kg/ha
 - Planting date: First half of January
 - Chemical seeds treatment
 - Protecting spray against fungi during the second half of March
 - Weed control when plant high reach 10 cm
- **The Optional Components:**
 - Reliable Seed source
 - Using drill for planting
 - Fertilizer rate: 100 Kg/ha of super phosphate
 - Using herbicide before planting
 - Using mechanical weed control
 - Using additional spraying (1-2) times when needed



Dissemination of Winter Chickpea

- **ICARDA in collaboration with the Department of Agricultural Extension and General Commission of Scientific Agricultural Research in Syria (GCSAR) have been playing a vital role in dissemination of winter chickpea technology in Syria.**
- **In 2005, ICARDA supplied through Agricultural Extension Directorate about 7.2 tons of seeds of Ghab4 and Ghab5 to farmers**
- **GOSM produced and distributed 575 tons of seeds of Ghab3 to farmers in 2005.**



Chickpea Varieties in Syria





- **In 2005/06 season, we intend to get information from the farmers regarding the performance of these cultivars in comparison with the traditional spring plantings to have impact analysis of winter chickpea technology and to know the constraints, if any, in adoption of winter chickpea technology for ICARDA back up research.**



Farmer's Field Planted by Winter Chickpea Seeds obtained from ICARDA





Objective of the Study

- **Document the adoption of winter chickpea in Syria**
- **Identify both biological and socioeconomic constraints that influence adoption process**
- **Assess the impact of this technology on rural household's livelihoods in terms of income increase, food security, and labor opportunities by gender**



Methodology

- **Review the secondary data**
- **Conduct Rapid Rural Appraisal**
- **Carry out a formal survey**
- **Data analysis using descriptive and econometric methods**

Training of National Extension and Research Systems in Syria on Implementation of Adoption and Impact Studies





Adoption Indicators

- Adoption rate

Represent the percentage of farmers adopting the technology

- Degree of adoption

Represent the proportion of land under the new technology

- Intensity of adoption

Adoption rate * Degree of adoption





Sample Distribution by Seed Sources and Provinces

Seed source	Provinces				Total	%
	Aleppo	Idleb	Hama/EI Ghab	Dar'a		
Research & Extension	30	37	24	30	121	26
GOSM	29	55	16	4	104	22
Research & GOSM	1	11	1	1	14	3
Other source	75	94	37	25	231	49
Total	135	197	78	60	470	100
%	29	42	17	13	100	

Farmers' perception on winter chickpea



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Comparing characteristics of winter chickpea to spring chickpea

- Frost resistance
- Ascochyta resistance
- Drought resistance
- Heat resistance
- Diseases resistance
- Insect resistance
- Yield under marginal conditions
- Earliness of maturity
- Needs more weeding
- Easiness for manual harvest
- Easiness for mechanical harvest
- Easiness for threshing
- Resistance to shattering
- Tillering
- Grain size
- Grain color
- Grain yield
- Straw yield
- Cooking time
- Price of grain
- Price of straw
- Taste
- Consumer demand

Comparing characteristics of winter chickpea to spring chickpea (% of farmers)

Characteristic	Winter is better	Spring is better	No difference	No idea
Frost resistance	64.2	8.3	6.1	21.3
Ascochyta resistance	48.9	16.9	11.4	22.8
Yield under marginal conditions	54.7	7.4	9.9	28
Earliness of maturity	72.3	6.1	2.5	19
Needs more weeding	54.6	8.7	17.9	18.9
Easiness for manual harvest	14	44.1	21.2	20.7
Easiness for mechanical harvest	71	1.8	5.6	21.5
Grain size	11	69.1	4.1	15.9
Grain color	14.5	53.7	11.9	19.9
Grain yield	66	7.9	6.1	20.1
Price of grain	14	58.4	9.2	18.4

Reasons for not growing winter chickpea in the following year (% of farmers)

Reasons	Zone		Total
	1	2	
Crop rotation	47	24	43
Affected by diseases or aschocyta	10	14	11
Low grain yield	6	3	6
Bad season, shortage in rainfall	6	28	9
No experience in growing it compared to spring variety	3		3
No guarantee to protect it as it could be stolen at green stage by passing people	3		3
Availability seeds from formal sector	6	17	8
Not accepted for economic reasons (lower market price, high weeding costs)	18	14	17
Total	100	100	100
N of observation	162	29	191



Factors affecting Productivity of Winter Chickpeas (% of farmers)

Factor	No affect	Low	Moderate	High
Variety	14.9	6.0	43.4	35.8
Previous crop	18.0	17.4	39.6	25.0
Time of tillage	14.9	17.4	46.5	21.2
Equipment of tillage	18.9	15.8	45.1	20.2
Date of sowing	4.7	5.6	39.4	50.3
Method of sowing	14.9	13.6	43.7	27.8
Seed rate	6.3	8.5	43.9	41.4
Seed treatment	8.2	12.3	30.4	49.1
P application	21.5	10.9	29.3	38.3
N application	35.2	22	30.6	12.2
Insects & diseases	3.8	5.8	19.9	70.5
Weeds	2.2	5	27.1	65.6
Ascochyta blight	4.2	8	15.7	72.2
Method of harvest	17.3	19.2	44.2	19.2

Characterization of household assets and wealth quartiles





Farmers' characteristics by wealth quartiles

Variables	Wealth quartiles			
	Lowest 25%	25%-50%	50%-75%	Highest 25%
Total holding area	5.0	6.6	7.1	22.2
Goat numbers	0.2	0.4	0.7	2.2
Family size	7	8	9	10
Having other skills beside the knowledge in agriculture	0.03	0.17	0.38	0.42
People generally trust one another in matters of lending and borrowing	0.19	0.50	0.71	0.70
Owned area	4.4	5.8	6.2	17.6
Having car	0.01	0.03	0.12	0.26
Farmer age	59	52	48	47
Distance between the house and paved road	27	37	73	178



Adoption of Winter Chickpea Varieties

	Adoption degree (% of winter chickpea)	Adoption rate (%)	Adoption intensity (%)
Zone			
Zone 1	65.7	64.0	42.0
Zone 2	65.8	72.7	47.8
Province			
Aleppo	85.6	75.0	64.2
Idleb	67.8	66.2	44.9
Hama/El Ghab	68.1	63.8	43.4
Dar'a	37.8	43.6	16.5
Wealth quartiles			
Lowest 25%	56.6	56.5	32.0
25%-50%	64.7	64.6	41.8
50%-75%	66.0	67.5	44.5
Highest 25%	65.7	73.3	48.1
Total sample	65.7	66.0	43.4



Adoption Rate of Main Components

(% of farmers)

Component	Zone 1	Zone 2	Both zones
N of observations	253	77	330
Seed rate	41.3	20.8	36.8
Planting date	54.7	42.9	52.0
Seed treatment	49.0	63.6	52.4
Fungi control	37.0	14.3	31.9
Weed control	67.9	41.6	62.0
Full package	1.1	0	0.9



Number of components adopted by farmers

No of components	Frequency	%
0 (only variety)	7	2.1
1 + variety	64	19.4
2 + variety	101	30.6
3 + variety	103	31.2
4 + variety	52	15.8
5 + variety	3	0.9
Total	330	100.0

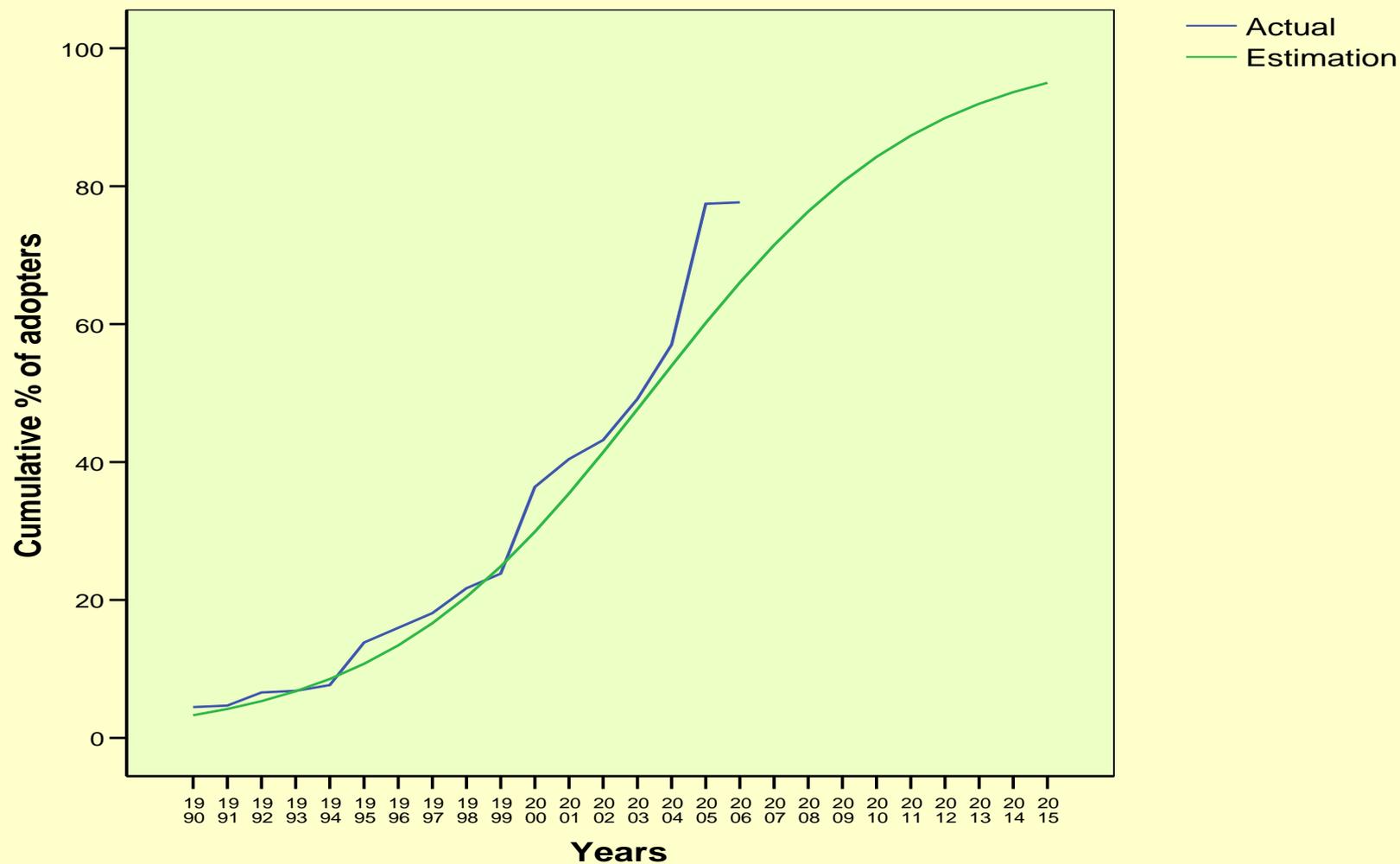


Adoption Rate of Optional Components

Component	Zone 1	Zone 2	Both zones
Reliable seed source	72.1	61.0	69.1
Using drill	64.1	57.3	62.5
Applying super phosphate fertilizer	70.3	44.2	64.2
Applying 100 Kg/ha of super phosphate	22.5	23.3	22.7
Using herbicide before planting	29.2	11.7	28.2
Using mechanical weed control	8.7	0	6.7
Using (2-3) spraying against Ascochyta	18.9	7.8	16.4



Diffusion of Winter Chickpea Varieties





Logistic Regression Analysis (Logit Model)

- A quantitative relationship between adoption and influencing factors was established to predict whether a farmer will or will not adopt the new technology.
- This relationship can be estimated by using logistic regression model.
- Logit model is a technique that can be used, for estimating the probability of adopting a new technology, given certain conditions.
- In this analysis, the model uses a series of characteristics of the farm and the farmer to predict the probability of adoption.

$$\text{Prob (Y=1)} = \frac{1}{1+e^{-(b_0+b_1x_1+b_2x_2+\dots+b_nx_n)}}$$



Factors influencing adoption of winter chickpea

Factor	B	S.E.	Sig.	Exp(B)
Zone	1.347	0.447	0.00	3.84
Total holding area	0.064	0.023	0.00	1.07
Having irrigation source	-0.877	0.317	0.01	0.42
Farmer's age	0.037	0.012	0.00	1.04
Chickpea yield in 2005	0.001	0.000	0.00	1.00
Wealth index	0.685	0.341	0.04	1.98
Participating in field days	0.724	0.377	0.05	2.06
Constant	-6.535	1.188	0.00	0.00

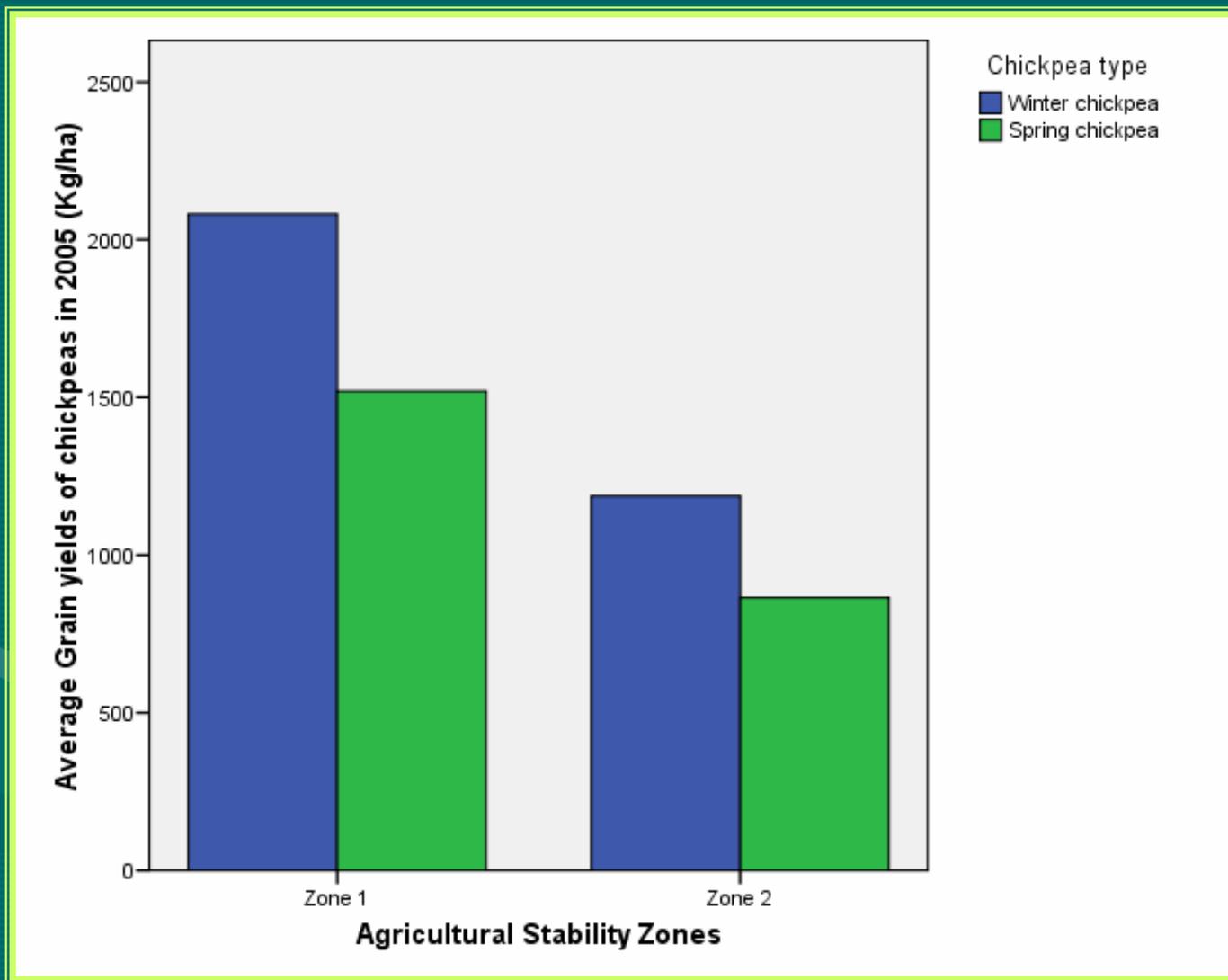
Impact on Productivity



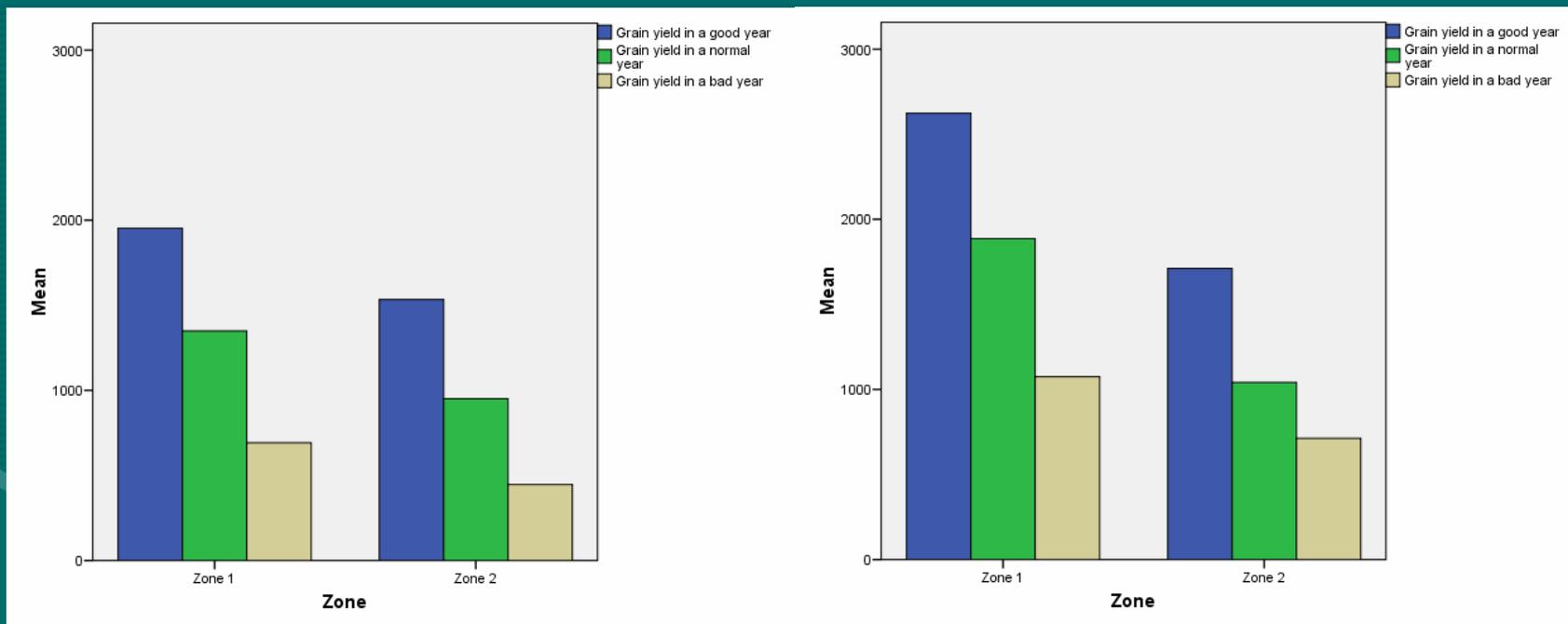
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Average Chickpea Yields in 2005 Season



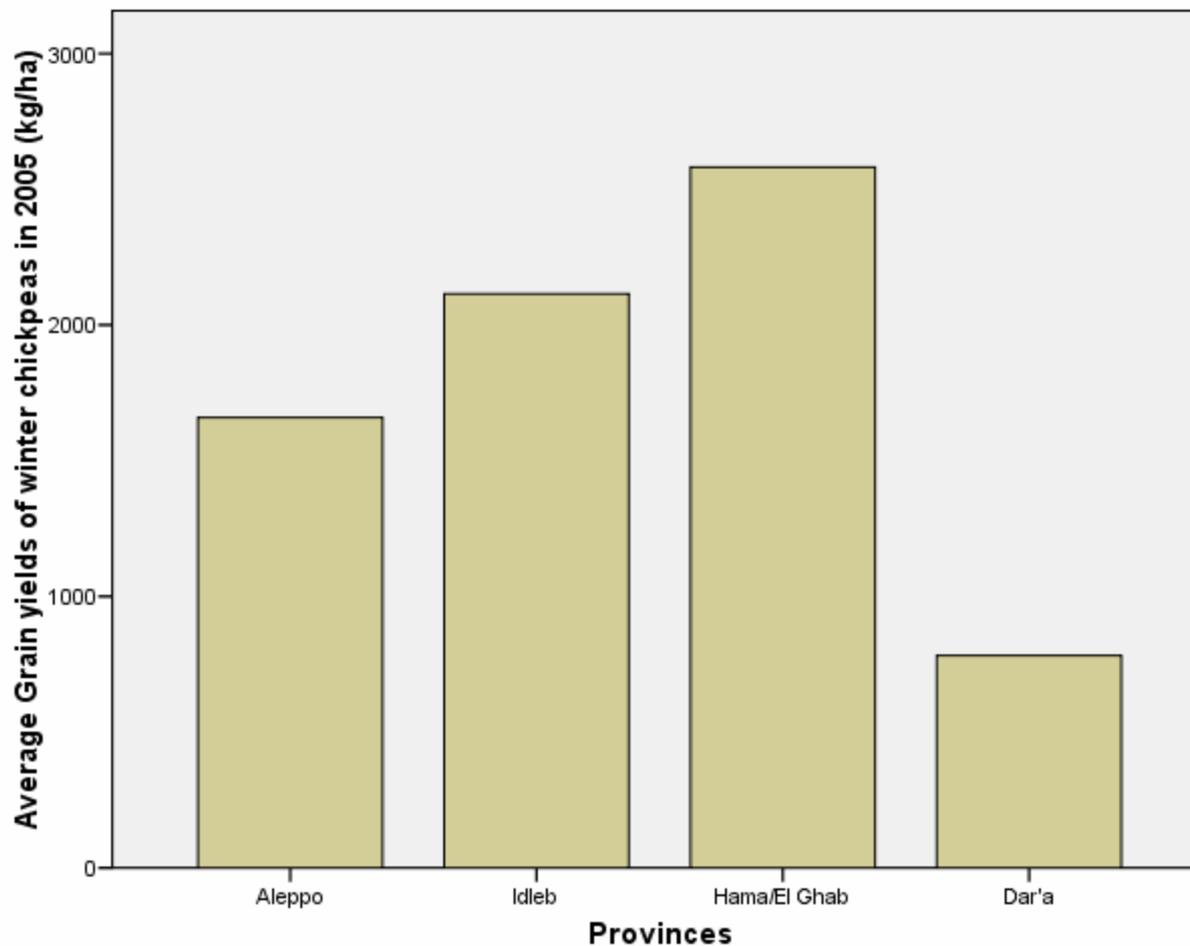
Estimated Average Chickpea Yields in Good, Normal, and Bad Seasons



Spring Chickpea

Winter Chickpea

Average Winter Chickpea Yields in 2005 Season



Estimated Multiple Linear Production Function for Chickpea

Variables	Unstandardized Coefficients		Standardized Coefficients	Sig.
	B	Std. Error	Beta	
(Constant)	-624.184	169.038		.000
rainfall rate in 2005	2.990	.271	.389	.000
Variety (Dummy)	379.941	60.960	.233	.000
Seed rate (kg/ha)	4.004	.867	.158	.000
Using supp irriga (Dummy)	379.952	104.944	.125	.000
Amount of super phosphate (46%) on winter chickpeas	1.070	.369	.108	.004
Using pest control 1 time	100.936	64.331	.055	.117
Using pest control 2 times	549.896	97.016	.207	.000
Total labor needed per hectare for chickpea	5.019	.836	.210	.000

Dependent Variable: Grain yields in 2005
 Adjusted R Square = 0.456 F(493, 7) = 51.22***



Estimated *Cobb-Douglas* Production Function

Variables	Unstandardized Coefficients		Standardized Coefficients	Sig.
	B	Std. Error	Beta	
(Constant)	-2.107	.559		.000
LN Rain	1.042	.070	.508	.000
LN Seed rate	.565	.081	.230	.000
LN Labor	.066	.023	.101	.003
Variety (Dummy)	.287	.040	.249	.000
Using supplemental irrigation (Dummy)	.322	.072	.149	.000
Using pest control 1 time	.059	.044	.045	.182
Using pest control 2 times	.237	.066	.126	.000

Dependent Variable: LN Grain Yield in 2005

Adjusted R Square = 0.484 $F(481, 7) = 66.65^{***}$



Estimated *Cobb-Douglas* Production Function by Zones

Variables	Zone 1		Zone 2	
	Coefficients	Sig.	Coefficients	Sig.
(Constant)	2.509	.004	-6.638	.000
LN Rain	.590	.000	1.602	.000
LN Seed rate	.181	.063	.858	.000
LN Labor	.076	.002	.063	.189
Variety (Dummy)	.280	.000	.163	.086
Using supplemental irrigation (Dummy)	.210	.005	.649	.001
Using pest control 1 time	.063	.175	.005	.966
Using pest control 2 times	.277	.000	.013	.960
Adjusted R square	0.278		0.542	

Dependent Variable: LN Grain Yield in 2005



Estimated the Net Impact of Winter Chickpea Variety

- The formula used:

$$\text{Net impact} = e^x - 1$$

x = coefficient related to variety in Cobb-Douglas Model

- Spatial distribution of yield gain due to shifting to winter production were:
 - 32.3% in Zone 1
 - 17.7% in Zone 2
 - 33.2% on the sample level

Impact on Profitability



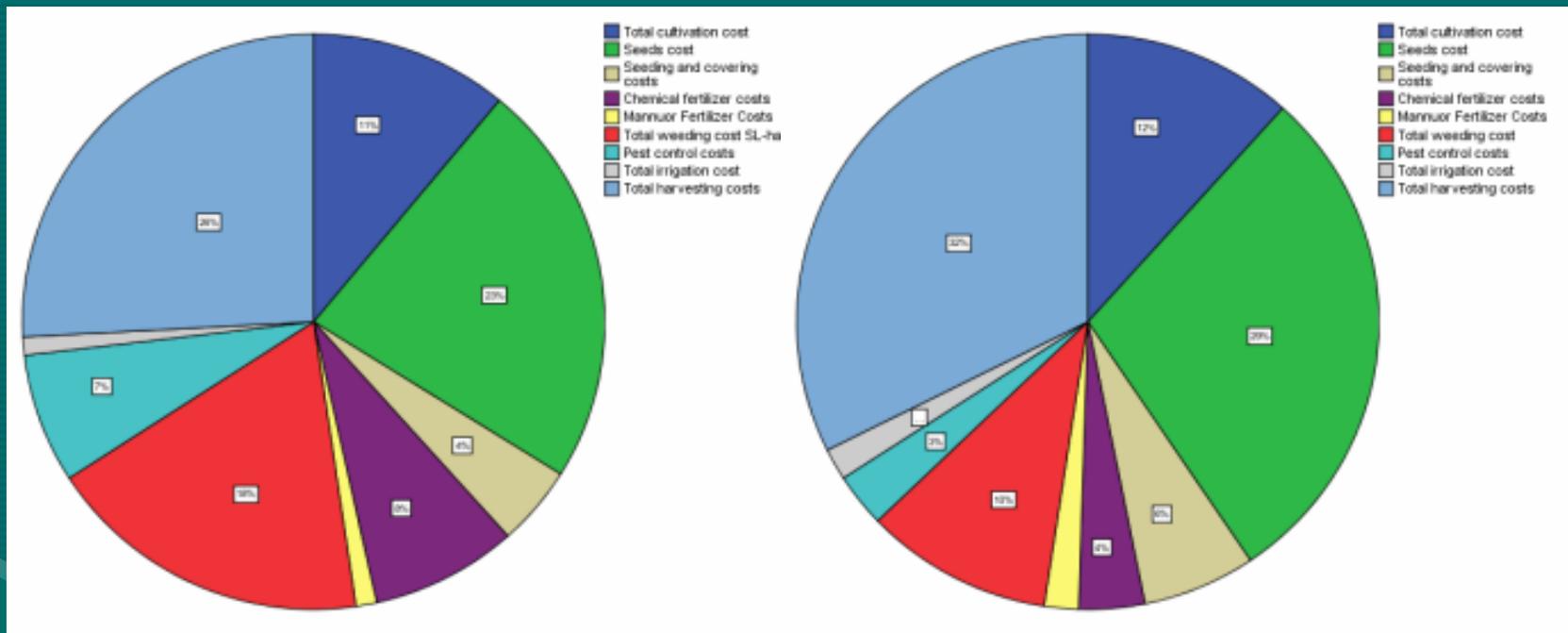
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Profitability of Spring and Winter Chickpeas

Item	Spring			Winter		
	Zones		average	Zones		average
	1	2		1	2	
Grain value	48624	26355	43465	64133	39266	58701
Straw value	3482	3110	3396	1980	1982	1980
Total revenue (SL-ha)	52106	29465	46861	66113	41249	60681
Total production costs	15723	14829	15603	20346	13755	18906
Net revenue (SL-ha)	36382	14636	31258	45767	27493	41775

Winter Chickpea Costs (%)



Winter Chickpea

Spring Chickpea

Differences in the Costs between Spring and Winter Chickpea

	Zones		average
	1	2	
Change in total revenue	14008	11784	13820
Change in total production costs	4623	-1073	3303
Change in net revenue (SL-ha)	9385	12857	10517



Costs and Revenue of Spring and Winter Chickpeas

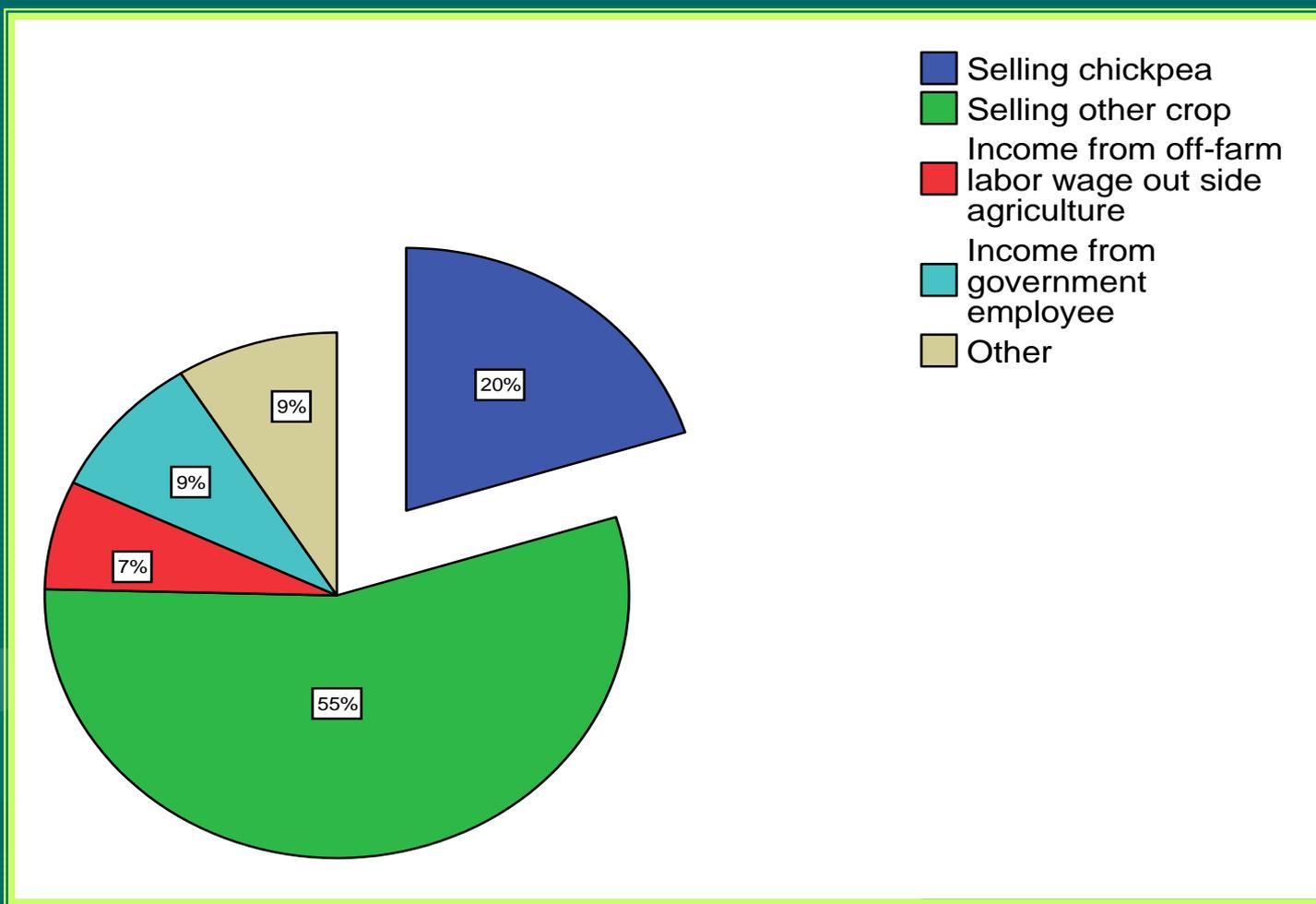
Wealth quartiles	Spring			Winter		
	Total Revenue	Total production costs	Net revenue	Total Revenue	Total production costs	Net revenue
Lowest 25%	50288	16098	34191	63122	19684	43437
25%-50%	45689	14641	31048	58074	18818	39256
50%-75%	46079	15960	30119	59935	18278	41657
Highest 25%	46458	16569	29889	62404	19204	43201
Total	47404	15839	31565	60869	18974	41895

Impact on Household Income

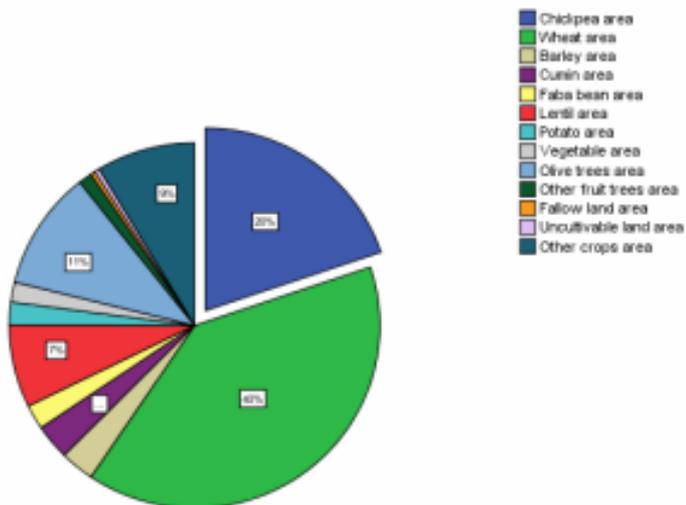


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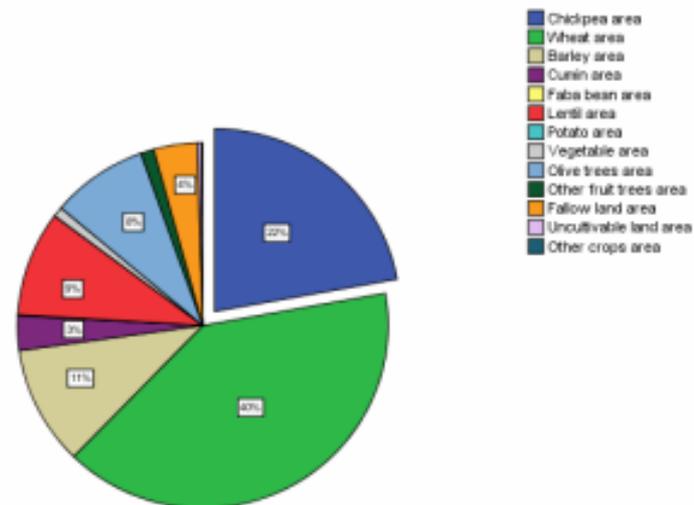
Income Sources



Land Use

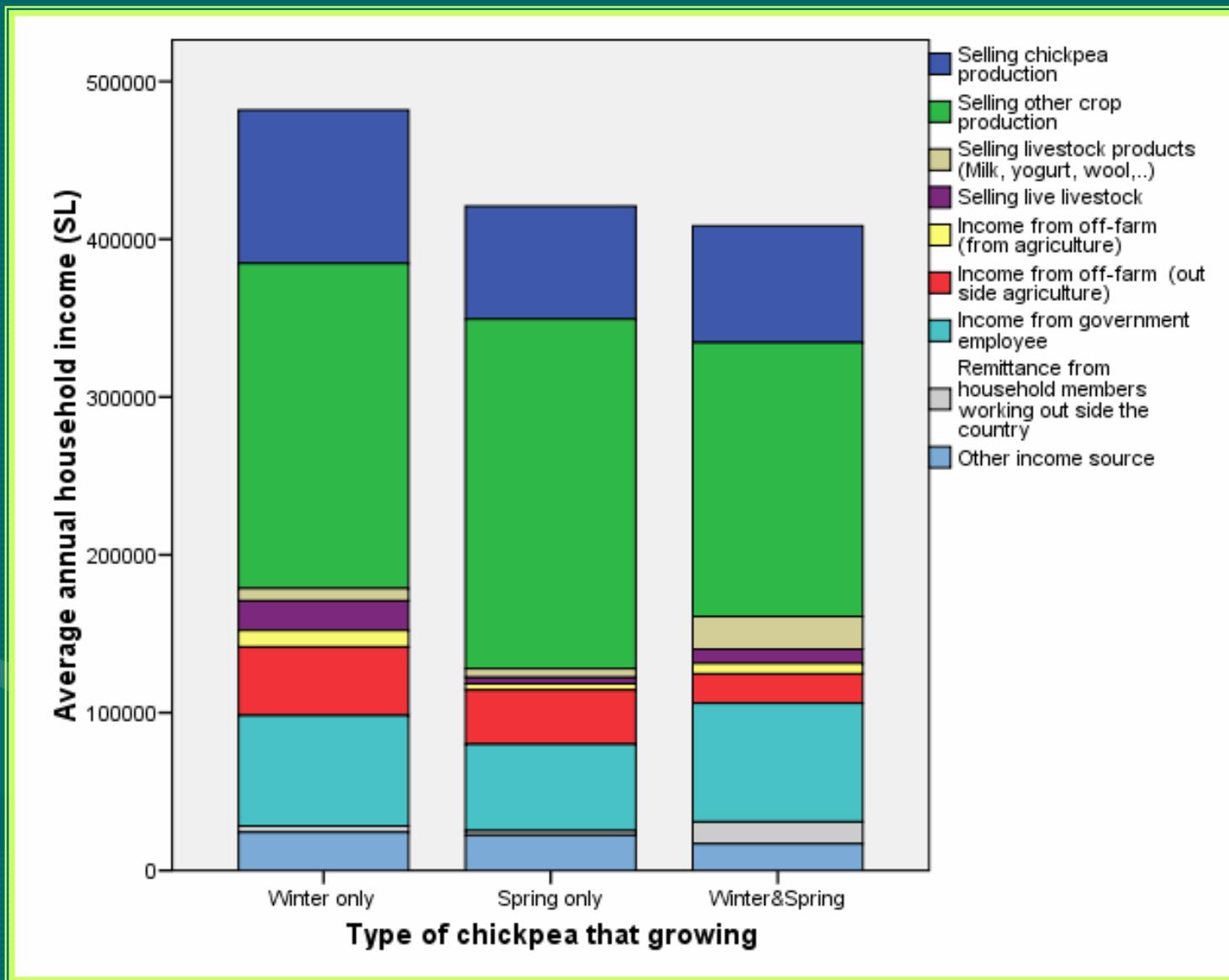


Zone 1



Zone 2

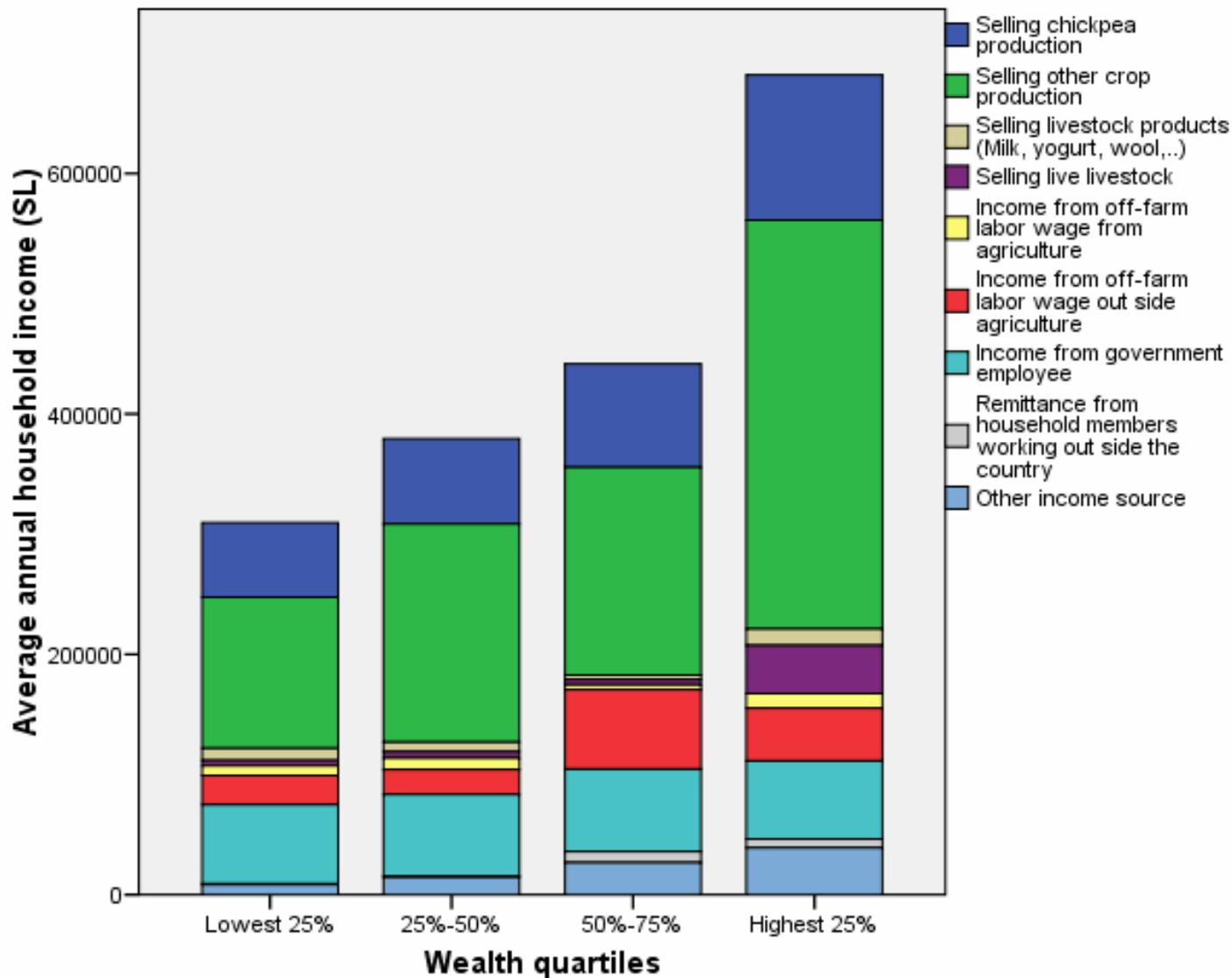
Average Annual Household Income





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Average Annual Household Income by Wealth Quartiles

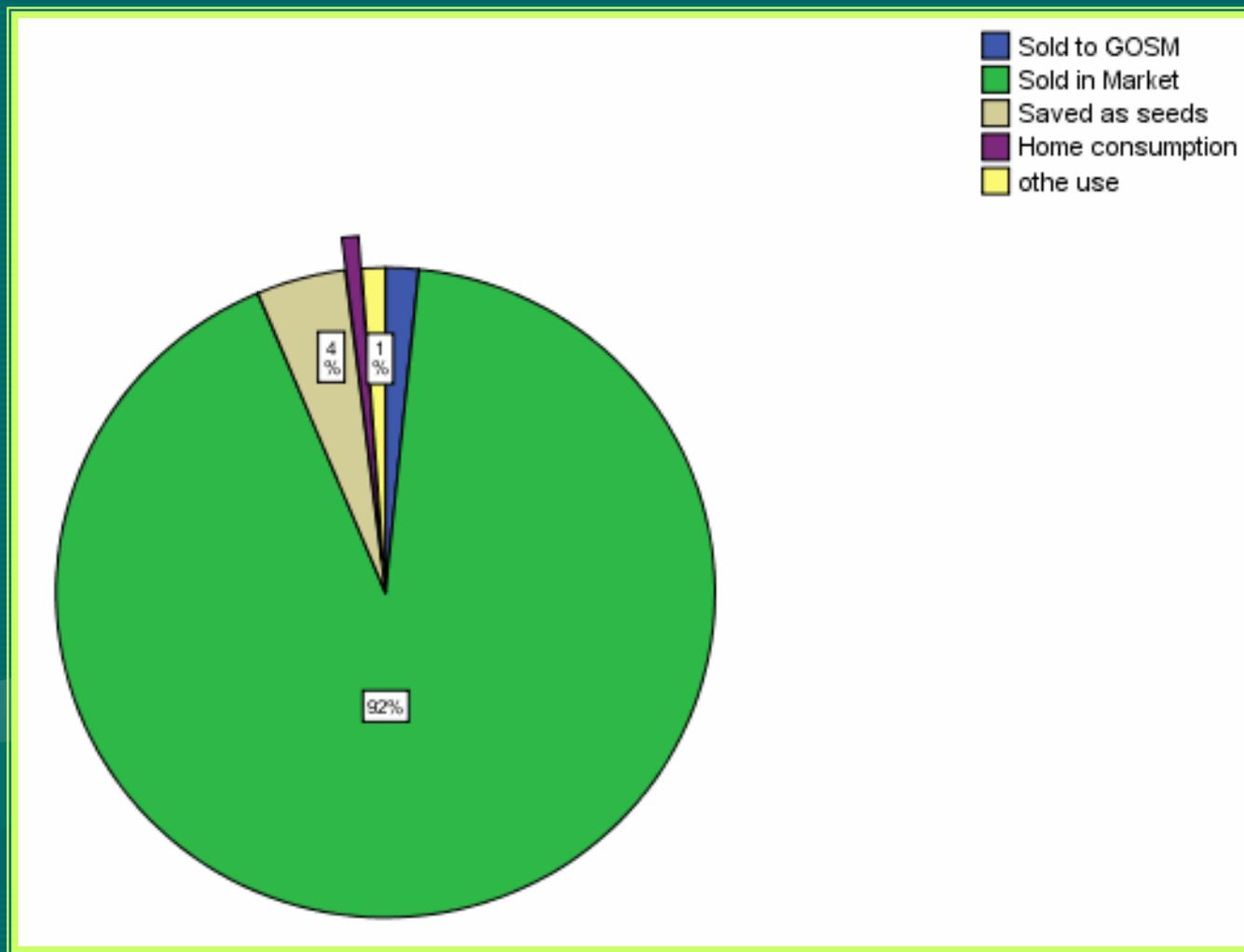




Contribution of Chickpea Selling into the Average Household Income (%)

Group	%
Growing winter only	22.8
Growing spring only	19.2
Growing winter and spring	21.2
Lowest 25%	23.2
25%-50%	21.3
50%-75%	21.7
Highest 25%	19.6
Total	21.7%

Winter Chickpea Production Disposal





Percentage of Winter Chickpea Production used as Home Consumption

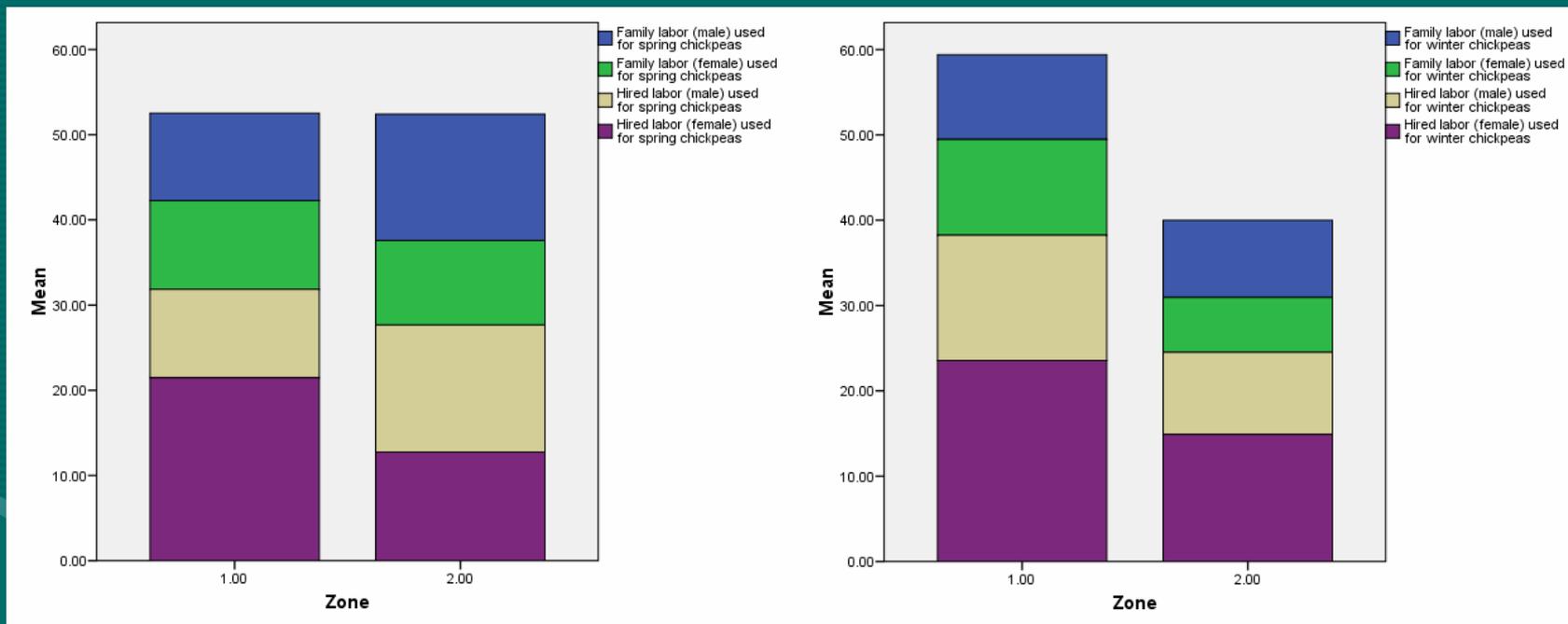
Wealth quartiles	% of total production
Lowest 25%	1.50%
25%-50%	0.94%
50%-75%	1.48%
Highest 25%	0.45%
Total	0.81%

Impact on Labors



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Estimated Number of Labor needed per Hectare for Winter and Spring Chickpea



Spring chickpea

Winter chickpea

Water Productivity

District	Grain yield (2005) of spring chickpea	Grain yield (2005) of winter chickpeas	Rainfall rate in 2005 (mm)	Water productivity (Spring chickpea)	Water productivity (winter chickpea)
Izaz	1269	1476	365.4	3.47	4.04
Al-Bab		1270	286.8		4.43
Samaan	1400	2013	396.3	3.53	5.08
Efreen	950	2550	385	2.47	6.62
Idleb	1765	2220	413.8	4.27	5.37
Harem	1500	1771	489.3	3.07	3.62
Ariha	1250	1636	549.3	2.28	2.98
El Ma'arra	1650	1696	340.8	4.84	4.98
El Ghab	1676	2741	562.8	2.98	4.87
Mesiaf	2000		402.7	4.97	
Mhardeh		2350	478.5		4.91
Jarablos		1524	283.5		5.37
Dar'a	803	652	298.8	2.69	2.18
Izra'	563	652	244.2	2.30	2.67
El Sanamein	712	1025	243.2	2.93	4.21
Average	1360	1826	378.7	3.59	4.82



Conclusion

- **Clear expansion in winter chickpea**
 - **Most farmers have adopted the recommended package components (more extension is needed)**
 - **Variety is widely adopted compared to other components**
 - **Expansion of winter chickpea in Zone 2 (new area)**
 - **Clear impact of winter chickpea technology in terms of**
 - **Productivity**
 - **Profitability**
 - **Water productivity**
 - **Poverty reduction**

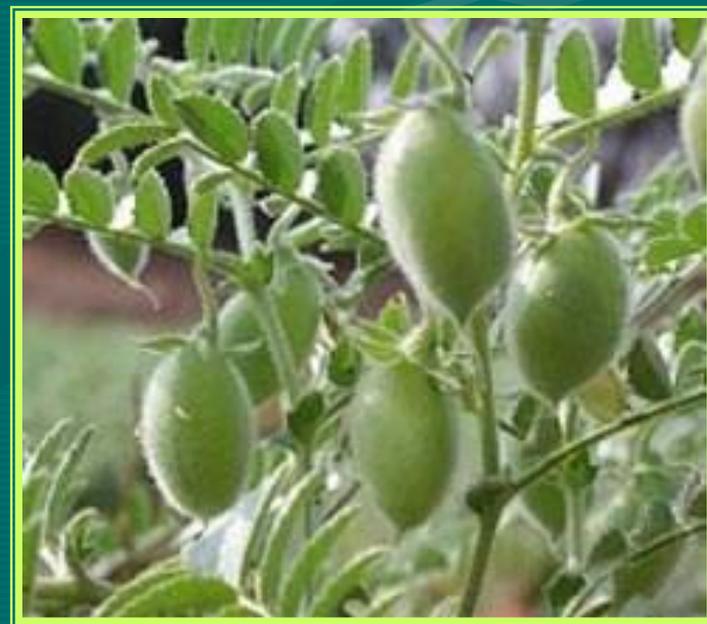


Recommendations

- **More investigation and monitoring of winter chickpea planting in Houran area of Syria (Dara' and Sweida) are needed**
- **Discuss with GCSAR the possibility to conduct on-farm trials on winter chickpea at Hasakeh province**
- **More focus on extension activities in Zone 2 in:**
 - **Al Bab, and Jarablus Districts - Aleppo**
 - **Saraqib and Maa'rah Districts - Idleb**

Thank you

for your attention





Lessons Learned



The slowness diffusion of winter chickpeas among farmers may be due to:

- The risk associated by growing the crop and effect of *Ascochyta* blight.
- Farmers perceive lack of full resistance to *Ascochyta*, and all winter chickpeas varieties are only tolerant.
- Lack of knowledge among some farmers on winter chickpea technology.
- Not enough knowledge among farmers on the type and quantity of chemical to be used for spraying, and there is no clear Extension Program for pest management on winter chickpea.
- The slowness in diffusion process may also contribute to the failure of winter sowing in some areas in some years due to failure to apply all the package components.



Expansion of winter chickpea cultivation in Syria

- Winter chickpea should be planted in January, unlike the spring chickpea. The criteria used by farmers are different in the two cases.
- The area planted by winter chickpea can be influenced by the following factors:
 - The price of lentil and cumin (substitute crops)
 - Tendency of neighboring farmers to grow the same crop (Dams' agriculture) i.e. when all farmers decide to plant only one crop due to the land property and the small area of each individual farmer (2 km long, 10 m wide), this doesn't allow every farmer to plant different crop.
 - Increase of age of olive trees affect farmers' decision not to plant winter or spring chickpea between the trees.



Expansion of winter chickpea cultivation in Syria *(Continue)*

- The importance of winter chickpea has been increased in the fertile land of Zone 2 in both Aleppo and Idleb provinces in the last 5 years.
- Chickpea area in Al Ghab region is relatively limited, and doesn't exceed 500 ha per year, mostly in winter chickpea. Many farmers harvest the chickpea while still in the green stage in early May and sell it for 3000-4000SL/dunum. Then farmers plant summer crops such as cotton or sugar beet, which increase the household income in the average by 25000 SL.
- Chickpea is planted in 25000 ha in Dar'a province, yet the adoption of winter chickpea varieties are still limited. More Extension activity is needed at that area.



The Wealth Index

- **Wealth index, based on the status of household assets, was used for ranking the households in the sample.**
- **In the wealth ranking, variables important in distinguishing households from each other were identified by Principal Components Analysis.**
- **Wealth quartiles have been used to explore patterns of income distribution in household**

a. Natural Capital

Total holding area (ha)	10.7
Total Owned area (ha)	8.8
Having irrigated land (%)	36
Using the water resource for irrigating chickpea (%)	8.5
Having sheep and/or goats	20% of farmers (25 heads)
Having cattle	10% of farmers (3 heads)
Distance between the house and paved road (m)	83

b. Physical Capital (% of farmers)

Having a tractor	32
Having a well	29
Having agri. equipment	25
Having shop	15
Having car	11
Having pickup/lorry	20
Having motorcycle	32
Having a bus	2

c. Social Capital (% of farmers)

Cooperative availability in the village	95
Cooperative membership	45
Perception of household member to be active in any collective action in the community	
- Leader	6
-Very active	25
-Somewhat active	63
-Not active	6
People generally trust one another in matters of lending and borrowing	51



d. Human Capital

Family size (person)	9
Experience in Agriculture (year)	25
Having other skills (%)	25
Having work opportunities outside the area (%)	21
Farmers' education (%)	
- illiterate	6
- read and write	27
- preliminary	26
- secondary	22
- university	19

e. Financial Capital

% of off-farm income	12
% of income from chickpea	21
Average annual income	403000 SL/household
Saving money last year (%)	29
Using credit for farm needs (%)	19
Classification of the livelihoods by farmers' perception (%)	
- very poor	1
- Poor	13
- moderately well-off	67
- well off	19



Created Wealth Index

- **The wealth index was created using Factor Analysis, a statistical technique similar to Principal Components Analysis. These analyses have the common objective of reducing the relationships between many interrelated variables to a small number of factors.**
- **However, the primary purpose of factor analysis is to describe the relationships among the many variables in terms of a few underlying but unobservable factors; several original variables are combined into a few derived variables.**



Variable included in Factor Analysis

- Total holding area
- Goat numbers
- Family size
- Having other skills beside the knowledge in agriculture
- People generally trust one another in matters of lending and borrowing
- Owned area
- Having car
- Farmer age
- Distance between the house and paved road



- In calculating the wealth index, the coefficients of variables estimated by factor analysis were multiplied by standardized values of the respective variables for each factor (X_i)
- Household-specific wealth indices were constructed from scores obtained from factor analysis, according to:

$$X^* = w_1X_1 + w_2X_2 + w_3X_3 + \dots + w_nX_n$$

where

- X^* is the score for each household.
- X_i is the value of factor i and has a zero mean and standard deviation equal to 1.
- w_i is weight, which is specified for the maximum variance of factor i