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Crop Water Use Efficiency by Type of Crop and Farming System in the Jordan Valley.

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Water Delivery Schedules and Crop Water Needs

Data from the KAFA'A farm survey covering the 2002-2003 crop season was used earlier to assess the comparative crop water use efficiency of irrigation water used in the Jordan Valley by crop type and by zone.

Cropping patterns among survey sample farms were matched with crop water requirements derived using evapotranspiration data and crop-specific coefficients to generate estimates of the value of production per 1,000 cubic meters of irrigation water. Preliminary results indicated that vegetable crops generate higher values of production per unit of water than either bananas or citrus crops. They also showed that crop water use efficiency in the Central Jordan Valley; where vegetable production predominates, was higher than in the North Jordan Valley where citrus is the major crop.

The validity of these findings has been called into question because crop water requirements have not been established specifically for the Jordan Valley areas. The theoretical values of water consumption requirements thus generated for all three groups of crops exceeded significantly actual water delivered by the Jordan Valley Authority to farmers in the Valley.

The attempt is made in this report to reassess the crop water use efficiency analyses using the regulation for irrigation water delivery estimates provided by the Jordan Valley Authority.

Tables 1-a, 1-b, and 1-c are the schedule of water delivery that the JVA uses to determine how much water to give to farmers, depending on the month and the type of crop. Three crop categories are given – bananas, citrus, and vegetables. For each category JVA stipulates how many millimeters of water to provide the farms for each type of crop per day (bananas, citrus or vegetables). Table 1-d condenses the same information for the three zones in an easy to read format. Bananas in the North Jordan Valley, for example, require 7 mm per day in the hot summer months, but only 3 mm per day in the cool winter months (See Table 1-d and Figure 1-a). Figures 1-b and 1-c provide the same information for the Center and South Jordan Valley.

Vegetable crops occupy the land only a few months each season. In Tables 1-a to 1-c, two separate seasons – autumn and spring – are considered. We note however that in summer months the allowance for vegetables drops to 1 mm per day while for both citrus and bananas water allocation reaches maximum levels. This occurs because JVA is discouraging vegetable production in summer months and reduces vegetable water allowance to a minimum, which most farmers use for soil sterilization. This part of the analysis is introducing a change in the water allocation for vegetables, reflecting a situation of actual needs of crops during the months they are on the ground.
Table 2-a is the same as Table 1-d for bananas and citrus crops but differs in the columns for water allowance for vegetables. We have set water deliveries of all vegetables at the maximum that JVA allows -- 2 mm per day during the entire year. This might be

overestimating actual needs of vegetable crops, especially on the cooler winter months. Results from subsequent analyses thus incorporate a bias against vegetable crops because their water needs are probably overstated. *Table 2 is designed to be interactive, so that analysts can modify any or all individual cell entries in the table, and all subsequent analyses automatically adjust accordingly.*

Tables 3-a through 3-c, also derived from information kindly provided by JVA (water allowance regulation) for this study, provide typical crop calendars for the main crops in the Jordan Valley. The shaded cells indicate the months when each crop occupies the land, and the numbers in the background indicate cubic meters of irrigation water allocated per dunum in each month. The season's total water allocated is merely the sum of the monthly entries in each row. Separate data are provided for the North, Center, and South Jordan Valley in Tables 3-a through 3-c and Figures 3-a through 3-c, respectively. Bananas water allocation is the highest (about 1,500 m3 per year per dunum), and citrus come second at about 1,000 m3 per year per dunum. For most vegetable crops annual water allocations range between 200 and 500 m3 per dunum, depending on the specific crop and on which months they occupy the ground.

Adjustment for Rainfall

One of the possible reasons for discrepancy between estimated crop water allocation and the actual volumes of water delivered and billed by JVA is that in months when there is significant precipitation JVA delivers significantly less irrigation water to open field crops, including citrus orchards. In the North Jordan Valley where the precipitation is highest, several months might pass without JVA delivering water to some farms.

According to rainfall information from the Jordan Meteorological Department, over a period of 20 years the North Jordan Valley receives on average 252 mm of effective precipitation in a season, compared with 222 mm in the Center Jordan Valley, and only 57 mm in the South end of the Valley. Effective precipitation is defined as the portion of rainfall that is usable by plants, after discounting for runoff and other losses.

The rainy season in Jordan is highly concentrated in the winter months. The first few rains start in October and continue through early June, but the bulk of precipitation occurs between December and March. Table 2-b provides the percentages of total rainfall in different months. These percentages were obtained from Jordan Meteorological Department data as they appear in an article by Sahar Aloul in The Jordan Times of Monday, November 8, 2004. The same percentage distribution values for the Jordan Valley were used, even though the overall distribution corresponds to rainfall in Jordan. When specific values can be obtained for the three zones in the Jordan Valley, those values can be inserted into Table 2-b to arrive at more refined estimates.

Between December and March, rainfall makes significant contributions to satisfy the actual crops water needs. In North Jordan Valley, rains provide 45 mm of effective precipitation in December; 58 mm in January, 53 mm in February, and 48 mm in March.

These values are sufficient for citrus and open field crops during the winter months, when evapotranspiration is at its minimum.

Therefore the crop water needs (better defined as *JVA needed allocations*) estimates are adjusted to account for the contribution of effective precipitation. Crops grown under greenhouse conditions do not benefit from rain because the plastic houses do not normally collect and store rainwater for crop use. JVA water allocations of open field crops and tree crops are therefore adjusted accordingly, to account for rain, depending on the month when those crops are on the ground. This is done and reflected in Tables 3-a, 3-b, and 3-c for the main crops and farming systems in the North, Center, and South Jordan Valley, respectively. Figures 3-a, 3-b, and 3-c also take the effect of rainfall into account. The cumulative values for water allocations during the season therefore reflect the supplemental crop water allocation needs to be provided.

The new estimates of water allocation needed for most crops are therefore reduced across the board, except for vegetables grown in greenhouses and multi-spans. Citrus in the North only require 751 m3 per dunum allocation, instead of the 1,003 m3 when rainfall was not taken into account. The values for bananas and open field vegetables are also reduced by corresponding amounts.

The survey questionnaire did not ask specifically when fields were planted and harvested. Then the averages of the annual values in Tables 3 for the alternative timing schedules were used. The complete set of crop water allocation needs for the valley is shown in Table 4. Some crops in the cropping pattern of the survey sample farms do not appear explicitly in Tables 3-a to 3-c. In those cases the estimates of water allocation needs for similar crops are used.

Table 5 consolidates the new water allocation needs estimates with the crop information from each survey sample farm, into a single spreadsheet labeled ZUCCFAV that stands for “zone, unit, crop, category, farming type, area, and value.” This is a large file with nearly 2,000 entry lines, one for each crop in each farm, but only an excerpt of that table is printed as an example.

Value per 1000 cubic meters of Water

Table 6 summarizes the total area, value of production, and water allocation needs for each crop in the survey sample in the Jordan Valley, sorted out by crop category so that all citrus appear together, and all vegetables are separate. From those values it is possible to compute the per dunum values for value and gross revenue less deductions for initial investments, and water allocation needs. It is also possible to compute the value of production per 1000 m3 of irrigation water, as well as the gross revenue less deductions for initial investment.

Tables 7-a, 7-b, and 7-c depict the cropping pattern in the North, Center and South Jordan Valley, and Figures 7-a, 7-b, and 7-c show the same information in a graphic mode.

These cropping patterns are already well known and described in a prior KAFA'A report. The values presented here are slightly improved because some anomalous cases were removed from the analysis. Citrus crops predominate in the North, with the main fruits being clementine, sour orange, and navel orange. Vegetable production dominates the Center Jordan Valley, with tomato being the principal crop, followed by potato, cucumber and zucchini. Tomato and eggplant predominate in the South, but zucchini, lettuce, maize and peppers are also present.

Crop water allocation needs and consumption are shown in Table 8, also derived from tabulations using data in Table 5. Clementine is by far the crop using the largest volume of water, followed by sour oranges, navel oranges, and bananas. Among vegetables, tomatoes use the largest quantity of irrigation water; followed by cucumbers, eggplants, zucchini, and potatoes.

Several simple tabulations are consolidated in Table 9 to generate Figures 9-a to 9-f. The value of production per dunum are illustrated by the four leftmost columns in Figure 9-a. Bananas are the most valuable crop per dunum, 1,036 JD per dunum. Vegetable crops come next with an average of 603 JD per dunum, and citrus crops with an average of 478 JD per dunum. (Note: the values of "other trees" comprise an assortment of fruits including olives, grapes, pomegranate, date palms, guavas, but there are too few observations in the sample and the group is too diverse for being properly viewed as a group). The four columns in the middle of Figure 9-a represent the water allocation needs of the four crop categories that result in bananas needing 1,447 m3 per dunum per year, compared with 786 m3 for citrus crops, and 260 m3 for vegetable crops. Note that effective rainfall has been already subtracted; these figures do not include water contributed by rainfall, only the supplemental irrigation water provided by JVA.

Value of production per 1000 cubic meters of irrigation water by crop category are shown by the four rightmost columns in Figure 9-a: Bananas generate 716 JD per 1000 m3, slightly more than citrus crops on average, 608 JD per 1000 m3. Vegetables crops, however, generate a remarkable value of production of 2,320 JD per 1000 m3, mainly because it only uses one sixth of the water needed by bananas, and three times less than citrus. These returns per unit of water are summarized in Figure 9-c.

Another way of viewing the same results is in Figure 9-b. Citrus crops occupy 37 percent of the land, use 56 percent of the irrigation water, and contribute 31 percent of the value of farm production. By contrast, vegetable crops occupy 57 percent of the land, use only 29 percent of the water, but contribute 61 percent of the value of production. The relative crop water use efficiency of vegetables in terms of value of production per unit of water is manifest.

A similar pattern can be discerned when water used is disaggregated by zone instead of crop category. Figure 9-d shows the value of production per dunum in North – 420 JD, Center – 852 JD, and South – 371 JD. In contrast, water allocation needs per dunum are highest in the North – 633 m3 per year, while the Center – 389 m3, and the South – 394 m3, consume over half as much. The net result is that crop water use efficiency in the

North is only 663 JD per 1000 m3 of irrigation water, while in the Center the same amount of water generates 2,189 JD, and in the South 941 JD. These results clearly reflect the predominance of citrus crops in the North and of vegetable crops in the Center. The relative efficiencies in crop water use by zone are summarized in Figure 9-f.

The North zone Valley consumes over 60 percent of the irrigation water in the Jordan Valley but contributes only 37 percent of the value of farm production (see Figure 9-e). By contrast, the Center zone consumes 26 percent of the water to generate 52 percent of the value of production. The South occupies an intermediate position, consuming 13 percent of the water and contributing 11 percent of the value of production.

Water Allocation Needs and Water Bills

The above analyses were based on estimates of crop water allocation needs derived from JVA's schedule of water deliveries for the main crop categories in the North, Center, and South zones of the Jordan Valley. JVA officers wonder to what extent these water allocation needs estimates correspond to actual water deliveries to farm units in the Valley.

To get irrigation water, farm owners are required to come in person to the local JVA stage office before the start of each month to request how many days per week of water are needed. These requests are monitored by JVA to ensure that they correspond to the needs of the farms, based on the area planted and growing stage of each crop and climatic conditions at the time. JVA schedules pumping days and hours at a given water pipeline depending on the requests submitted by farmers served by the line. The ditch rider is the person responsible for ensuring compliance by farmers with the schedule. Farmers requesting two days a week are fined 150 JD if they open their FTA valves on days other than those requested and authorized. Most farmers simply request the maximum number of days.

Farmers are billed by JVA according to the estimated volume of water delivered to each farm. These estimates are made based on the number of days requested by farmers in a given line, prorated by the areas in each crop category in the farm, and the total volume of water pumped through the water line in that month. Water flow meters in each FTA are not really used to measure the volume of water received by each farm. JVA has lost confidence in flow meter measurements because they suspect some farmers tamper with the mechanism. Too many meters are not in working order and JVA has insufficient logistic and technical capabilities to keep up with the repair demands. Farmers often complain that their water bills bear little resemblance to actual water received, especially farmers at the end of the line where the pressure is lower than at the head.

JVA billing structure tariff rates at present are 8 fils for the first 2,500 cubic meters in a month, 12 fils for the next 1,000 m3, 20 fils for the next 1,000 m3, and 35 fils for any volume above 4,500 m3 per month. (For comparison purposes, the rates reportedly paid by Amman residents average over 400 fils per cubic meter). A typical 30 dunum farm

using 2 mm per day would consume 1,800 cubic meters per month (1,800 = 2*30 days*30 dunum), and therefore be eligible for the lowest rate of 8 fils/m3.

Water costs represent a very small share of the value of the crop. The water bill for a citrus farmer who requests an average of about 1,000 m3 per dunum per year, would only amount to 8 JD per dunum per year, less than 2 percent of the value of the crop, estimated between 400 and 500 JD depending on the specific citrus fruit.

What relationship do water bills have with the water needs of the farms?

The answer to this question would allow us to judge the validity of the water allocation needs estimates done above in this report. Ideally, a close correspondence between the water needs of a farm unit and the total water bill received for the season would verify that estimates of water allocation needs based on JVA's water delivery schedules are effectively applied in practice.

The Jordan Valley Authority kindly provided KAFA'A the record of monthly water bills to most of the survey sample farm units in the Jordan Valley. These records are summarized in Table 10, which provides total water volume billed per calendar year and per agricultural year (August to July). The column of most interest is for the 2002-2003 season, covering the same period as the farm survey.

Table 11 consolidates information for each sample farm unit, including the estimate of water allocation needs based on the cropping pattern, and the JVA water bill for the 2002-2003. Figure 11 is a scatter diagram, each sample farm represented by a dot, with water allocation needs in the horizontal axis and water bills on the vertical axis. Dots close to the diagonal line show a very good match between water bills from JVA and water allocation needs as estimated using water delivery schedules. Dots above the diagonal correspond to farms that are billed for more than they need, and dots below the diagonal are farms receiving less water than allocation needed. (Note: it is assumed here that water bills are accurate reflections of water delivered to farms).

It is clear from the chart that for most farms, there is little correspondence between water allocation needed and the volume in the water bills, because most dots are far from the diagonal line. The correlation coefficient between water allocation needs and bills is only 0.34 (R-Square 0.11), indicating a week relationship between the two values. Most of the variation in water bills among farms cannot be attributed to the irrigation allocation needs. The average farm bill is for 16,950 m3 with a standard deviation of 9,184; the average estimate of water allocation needs per farm is 16,022 m3 and a standard deviation of 12,241 m3. Thus, the total amount of water billed roughly matches the volume allocation needed, but the deliveries among farms do not match their particular needs.

It would be of some interest to determine whether farms above the diagonal – those receiving more water than needed – share some common characteristics. As a first approximation, we distinguish between vegetable farms and those producing citrus and

other tree crops (including bananas). Vegetable farms are those where more than half of the area is planted to vegetable crops. Figure 12 uses circles to distinguish vegetable farms from the diamonds used for tree farms. It is remarkable that most of the vegetable farms are congregated to the left of the graph and mostly above the diagonal line, while most tree farms are below the diagonal. This indicates that most citrus and other tree farms are billed for less water than allocation needed, while vegetable farms are billed for more water than allocation needed. In other words, most vegetable farms are getting more water than their allocation needs, while the contrary is true for most tree farms. There is potential water saving opportunities among vegetable farms that could be tapped if there were proper incentives to farmers to do so.

Another possible line of inquiry is to relate the amount of water billed (and supposedly delivered) with the actual number of dunums planted to bananas, citrus, vegetables, and other tree crops. This is accomplished using the standard statistical regression procedures available in the spreadsheet. For each farm unit in the Jordan Valley survey sample we regress the 2002-2003 water bill against the areas planted to these four crop categories. We have a total of 383 farms for which we have a complete set of data. Table 13 shows the summary results of the regression analysis and Figure 13. The following equation was obtained through the least squares procedure used in the regression analysis:

Water bill in m3 = 867 * banana dunums
+ 487 * citrus dunums
+ 640 * other trees dunums
+ 446 * vegetable dunums

The explanatory power of this equation to predict actual water bills is only 12 percent (R-Square = 0.12), but the crop coefficients are all highly significant. For each banana dunum JVA charges on average for 867 m3; for citrus trees 487 m3, and for vegetables 446 m3. These values suggest that water deliveries for citrus are only slightly higher (487 m3) than for vegetables (446 m3), and that bananas get only double (867 m3) the amount of water than say, potatoes (446 m3). How much these values correspond to actual water deliveries remains an open question. Most (88 percent) of the variation in water bills remain unexplained.

A slight improvement in explanatory power is shown in Table 14 and in Figure F 14. Regression analysis is also used to estimate another equation in which the intercept coefficient is not zero:

Water bill in m3 = 10,408
+ 509 * banana dunums
+ 214 * citrus dunums
+ 352 * other-trees dunums
+ 187 * vegetables dunums.

The explanatory power is raised to 14 percent (R-Square = 0.14) and the crop coefficients remain strongly significant; but most (86 percent) of the variation in water bills is not explained by the crop pattern. This equation says that on average a farm was billed for

10,408 m3 for the 2002-2003 season, plus 509 m3 for each dunum in bananas, plus 214 m3 for each dunum in citrus, plus 352 m3 for each dunum in other fruit trees, and 187 for each dunum in vegetable crops. The difference in the 2002-2003 season water bills for citrus (214 m3) and vegetables (187 m3) is therefore minimal (27 m3). Seemingly, the water bills reflect little difference in water delivered to citrus farms and to vegetable farms, the two major crop categories. Water delivery to farms apparently bears little resemblance to the water allocation needs that JVA uses to estimate water delivery schedules.

Adjustments for Initial Investments

One of the main findings from the KAFA'A Jordan Valley Farm Survey has been that water used in vegetable crops on average yields higher value of production per ton (cubic meter) of water than other crop categories.

This overall finding has been questioned on several grounds: First, vegetable production includes a diversity of farming systems, from open fields to green houses, and multi-span structures. Second, the value of production neglects to take into account the high investment required to establish green houses and multi-span structures to produce winter vegetables in the Jordan Valley. This section attempts to address these concerns by introducing rough estimates of initial investments required by each crop category and farming system.

Table 15 summarizes preliminary calculations to estimate appropriate deductions from the value of production to account for amortization of large investments in crop production. These include greenhouses for vegetables but also estimates of establishment costs for citrus orchards and banana fields.

Current costs for greenhouses in 2004 were about 1,300 JD for the metal frames and 300 JD for the plastic covers. The metal frames can be used over a period of 10 years but the plastic covers only last 3 years. Amortization rates computed with a 12 percent rate of interest amount to 230 JD for the frames and 125 JD for the plastic cover, for a combined yearly amortization payment of 355 JD per dunum. The cost of greenhouses has increased significantly in the past couple of years. In 2002-2003, the crop seasons covered in the farm survey, the reported cost of frames was 1,000 JD and the plastic covers 200 JD. Amortization cost were only 177 JD for the frames and 83 JD for the plastic, for a combined annual amortization cost of 260 JD. This cost is then subtracted from the value of production in the survey data for vegetables plots using greenhouses or multi-span technology. Greenhouses can also be rented in the Jordan Valley and the reported rates per season vary between 250 and 300 JD, roughly corresponding to the estimated amortization payment.

There are no readily available estimates on the cost of establishment of citrus orchards in the Jordan Valley. Commercial production in citrus begins in the fifth year. Farmers need to advance the initial cost of purchasing and planting the trees, setting up the irrigation system, and then nurturing the orchard for the next four years. Preliminary rough estimates of annual outlays per dunum are: 303 JD for the first year, and 114 JD for each of the following three years. At the beginning of the fifth year, these outlays plus accruing interest charges at 12 per cent add up to a cumulative investment of 908 JD per dunum. This investment is amortized over an estimated 20 year productive life span for the orchard. An annual amortization costs for citrus orchards is 122 JD is therefore subtracted from the value of production of all citrus varieties in the farm survey.

Banana trees do not require as long a period before they begin production in the second year. For purposes of this exercise and in the absence of better estimates, we estimate an

initial establishment cost for bananas of 483 JD per dunum. This initial cost, amortized over a period of 10 years at 12 percent interest rate, requires an annual amortization payment of 85 JD per dunum.

No information is easily available about establishment cost for other fruit trees, such as for guava, olives, date palms, grapes, and pomegranate. The same annual cost as for citrus is assumed for all other fruit trees, as a preliminary assumption for the purposes of this exercise, but better estimates should be substituted as they become available.

A new variable – Revenue – is introduced into the survey database ZUCCFAV (See Table 5), computed as the value of production less the above deductions for initial investment costs, depending on the crop category and farming system. We are then able to carry out the same analyses done before for value of production, but now using the Revenue column to bring all crops into comparable bases as annual vegetable crops on open fields where only current season costs are covered.

Table 16 comprises several tabulations using the Revenue variable (value of production less deductions for initial investments) and serve to generate a new set of accompanying figures to illustrate the comparative water use performance of crop categories. Figure 16-a shows the gross Revenue values per dunum of bananas (951 JD), citrus (356 JD), other trees (163 JD), and vegetables (569 JD). In the same Figure 16-a are shown the water allocation needs values calculated earlier in this report, after making allowance for the contribution of rainfall: 1,447 cubic meters per dunum of bananas, 786 for citrus, and 260 m3 for vegetables. From these two sets of figures we can compute the Revenue per 1000 cubic meters of water delivered by JVA that are shown in the right most set of columns in the graph: 657 JD for bananas, 453 JD for citrus, and 2,192 JD for vegetables. Once again, the revenue per unit of water used in vegetables is five times higher than in citrus, and three times higher than in bananas.

The relative magnitudes of gross Revenue per unit of water in vegetables over citrus and bananas are higher than those when the Value of Production was used. The obvious explanation is that the 260 JD deduction is only about ten percent of the value of production in greenhouse vegetables, while the deduction of 122 JD for citrus is about one third of the value per dunum of citrus.

Adjustments for Farming System in Vegetables

Another critique of the comparative analyses of water efficiency use in different crop categories is that the vegetable category combines both open field and greenhouse vegetables and that obscures the comparison in favor of that category. It should be of interest of see how open field vegetables perform as a separate group from greenhouse vegetables. Other tabulations included in Table 16 are used to obtain disaggregated values for vegetables in the four farming systems used in the Jordan Valley: 1 for open field, 2 for plastic tunnels, 3 for greenhouses, and 4 for multi-span structures.

Figure 16-b shows the areas planted in the survey sample farms to bananas (394 dunums), citrus (4,804 dunums), other trees (434 dunums), and vegetables (7503 dunums) in four farming systems. Open fields are by far the predominant farming system used for vegetables (6,456 dunums), followed by greenhouses (867 dunums). Only 97 dunums of vegetables were reported in multi-spans and 83 dunums in plastic tunnels.

Values of Production per dunum are shown in Figure 16-c for each crop and farming system category, while gross Revenues excluding deductions for initial investment are show in Figure Y4. The values of production for bananas, citrus and other trees are already known: 1,036 JD, 478 JD, and 284 JD per dunum, respectively. Values of production for vegetable vary greatly from 346 JD for open fields, 640 JD for plastic tunnels, to 2,371 JD for greenhouses and 1,836 JD for multi-spans. Plastic greenhouses clearly contribute to a four to six fold increase in value per dunum over open fields and simple plastic tunnels.

After excluding deductions for initial investment, gross Revenue per dunum of vegetables are reduced significantly for greenhouses and multi-spans to 2,110 JD and 1,575 JD respectively (See Figure 16-d). The values for open field and simple plastic tunnel remain unchanged at 346 JD and 640 JD, respectively. Revenue per dunum of bananas and citrus are also reduced to 951 JD and 356 JD respectively. For citrus, a deduction for initial investment of 122 JD from the value of production of 478 LD represents a reduction of 25 percent. By contrast, subtracting 260 JD for amortization of infrastructure from the 2,371 JD value of production of greenhouse vegetables only represents a reduction of 11 percent. Note: these revenue comparisons are valid for evaluating future returns to water use in different crop categories. Once orchards are established, sunk costs lose relevance because they cannot be recovered if citrus orchards were to be replaced by other crop types.

Figure 16-e recalls estimated water delivery allocation needs after allowance for rainfall for bananas (1,447 m3 per dunum), citrus (786 m3), and other trees (900 m3). The new values for vegetables are 236 m3 per dunum in open fields, 409 m3 for plastic tunnels, and 408 m3 for greenhouses, and 416 m3 for multi-spans. The higher values for the latter reflect the longer life span of vegetables grown under greenhouse conditions.

It is now possible to compare returns per unit of water by crop and farming systems category, using both the value of production and revenue after deductions for initial investment costs. Figure 16-f depicts graphically those values for 1000 cubic meters of water. For bananas, revenue per 1000 m3 dropped from 716 to 657 JD. For citrus returns declined from 608 JD in value terms to only 453 JD after deductions for cost of establishing the orchard. For vegetables in open field and under simple plastic tunnels returns per 1000 m3 are 1,470 and 1,562 JD respectively, three to five times the revenue for citrus. Returns per 1000 m3 in greenhouse vegetables, and in multi-spans are remarkably high: Value of production of 5,811 JD per 1000 m3 for greenhouse vegetables declined to 5,173 JD when deductions for amortizations of the infrastructure are done. For vegetables grown under multi-spans, value of production of 4,411 JD per 1000 m3 declined to 3,786 JD after deductions for amortization of infrastructure.

Introduction of greenhouses and multi-span structures in vegetable growing in the Jordan Valley has clearly resulted in increased efficiency in the crop use of water, both in comparison to traditional citrus crops as well as open field vegetable production. Expansion of vegetable production using greenhouse technology offers an obvious opportunity for irrigation authorities to increase the value added in agriculture from the limited water resources available. Farmers in the valley should be encouraged to shift vegetable production from open fields to greenhouses, and every year more and more farmers are doing so. Irrigation officers also report that some citrus farmers have taken the decision to cut down low productivity citrus orchards and convert the land to vegetable production. Such transfers from citrus to greenhouse vegetables would result in manifold increase in crop water use efficiency; however, other factors (no only water use, but climate and soil suitability, marketability season) should be taken in account when recommending changes in cropping patterns.

The current situation for citrus should be improved by providing training for farm labor, managers, and owners, as well as extension agents on farm practices in citrus management, i.e. pruning, weed and pest control, fertigation, irrigation scheduling, and post-harvest technologies like: harvesting, grading, cooling, waxing, and packing.

Identifying what steps irrigation and agricultural authorities might adopt in order to encourage farmers to shift water use from low productivity crops and farming system to high productivity uses is beyond the scope of this modest repot.

Conclusions and Recommendations

1.- This revised analysis of crop water use efficiency in the Jordan Valley basically confirms and validates preliminary findings of an earlier study using the KAFA'A farm survey. Measuring efficiency in terms of value of production per unit of irrigation water, vegetable crops consistently yield higher values than citrus crops and/or bananas. The value of production per unit of water is also highest in the Center Jordan Valley, where vegetables predominate, and lower in the North where citrus crops predominate. Feasibility studies for production of alternative crops for each of the J.V. areas (North, Center, South and Southern Ghors) should be performed before recommendations on changes on cropping patterns are made.

2.- It should be noted that while JVA is mandated to manage and distribute irrigation water for agriculture in the Jordan Valley and Southern Ghors, the constant shortage of water (mostly from spring to fall) in the country, renders JVA short of meeting the water deliveries for crops water requirements in the farms.

3.- In this new analysis crop water allocations needs has been estimated based on the Jordan Valley Authority time-specific schedules of irrigation water delivery for the three zones in the valley, separately for bananas, citrus, and vegetable crops.

4.- This analysis also incorporates the contributions made by rainfall during the winter season to reduce the allocation needs for irrigation water from JVA. Winter vegetable crops grown under greenhouses do not benefit from rainfall, but citrus orchards and other open-field crops have their water allocation needs reduced according to the effective precipitation per month in each specific zone.

5.- Also disaggregated the vegetable crops according to the farming system, to distinguish between greenhouse vegetable production and vegetable grown in open fields or simple small plastic tunnels.

6.- Bananas generate higher value per dunum (over 1,000 JD) than citrus (nearly 500 JD) and vegetables as a group (about 600 JD). When vegetables are disaggregated, the value of production of open field vegetables drops to less than 350 JD per dunum and for greenhouse vegetables rises to about 2,000 JD per dunum.

7.- Bananas also need more water per dunum (over 1,400 m3) than citrus (under 800 m3). Open field vegetables water needs are less than 250 m3 per dunum, after allowing for rainfall, because they are on the ground only a few months during the cooler part of the year. Greenhouse vegetables need over 400 m3 per dunum because they do not benefit from rain and stay on the ground longer.

8.- Crop water use efficiency measured as value of production per 1000 m3 of water is highest for greenhouse vegetables (over 5,000 JD) while for open-field vegetables is about 1,500 JD. Bananas generate about 700 JD per 1000 m3 of irrigation water, more than citrus crops as a group which generate over 600 JD per 1000 m3.

9.- Taking into account the high initial investment cost required by greenhouse vegetables significantly reduced their values for returns on water. Accounting for establishment costs of tree crops also affected the returns per unit of water of citrus and bananas. However, the overall relative magnitudes of returns per 1000 m3 were not appreciably affected by the introduction of deductions for amortization of initial investment requirements (See Figure 16-f).

10.- There is ample scope for introduction of water saving and yield enhancement technologies to raise the productivity of irrigation water. Production of bananas under artificial shade (mesh), for example, is reported to increase yields and reduce water consumption significantly. Citrus yields and quality of fruit can also be enhanced through improved production methods and shifting trees from low value fruits (clementines, for example) to high value fruits (navel oranges, for example).

11.- Expansion during the past decade of vegetable production under plastic houses has resulted in a major jump in productivity per unit of water. There is ample potential for expansion of greenhouse production in the Jordan Valley because at present they occupy less than 12 percent of the vegetable crop area in the valley. KAFA'A might focus attention on promoting the adoption of greenhouse technology among vegetable farmers.

12.- This water-use analysis is based on gross value of production estimates derived from the farm survey. A more rigorous economic analysis requires better consideration of the structure of production costs and initial investments for each major crop in the Valley. At this stage it is difficult to make farm level specific recommendations because of lack of better understanding of the profitability of different crops and how it might be affected by alternative interventions. KAFA'A might dedicate some effort and resources to filling this void, carrying out a brief crop budget survey to determine the structure of production costs and revenues.

13.- This study also found a large discrepancy between irrigation water allocation needs, as estimated from JVA water schedules, and actual water billings to each farm in the survey sample. This poor correspondence between water schedules by crop and water bills indicate that either water deliveries do not match the cropping patterns of farms or that the billing procedures do not accurately reflect actual water deliveries, or both. A more in-depth analysis about the weak association between water bills/deliveries and farm water needs is warranted to identify where the discrepancy arises.

14.- Preliminary analysis suggests that citrus farms are getting less water (as shown in their bills) than their estimated allocation needs. By contrast, a large proportion of vegetable farms are getting more water (and being billed accordingly) than what they need based on their crop pattern. In either case, there is a need to reach a better match between how much irrigation water individual farms need and what they get. KAFA'A efforts to encourage movement toward this goal are recommended.

15.- There might be a great opportunity for higher water productivity and efficiency among vegetable farmers in the Jordan Valley. One possible reason why vegetable farmers use more water than they need is that they neglect to turn off the FTA valves once they get what they need. Without water flow meters being used to measure farm water intakes, farmers do not benefit from turning off the valves or otherwise saving water. A demonstration trial for a few months is suggested to determine how much farmers adjust irrigation water consumption when presented with tangible benefits for water savings. Such a trial might provide basis for estimating a demand schedule for irrigation water and potential gains from introducing market elements in water use.

16.- A few citrus farmers are reported to have taken the decision to cut down orchards and switch their land to vegetable production instead. From the above analysis there are substantial gains in productivity of water from transferring cropland from citrus to vegetables. There are many potential inducements that agricultural and water authorities might adopt to encourage farmers to make this switch. KAFA'A might identify what are the most significant impediments preventing citrus farmers to take this decision or to introduce higher yielding technologies.

17.- Better billing procedures for irrigation water could contribute greatly to increase overall water use efficiency. At current low rates (8 fils per m3 for the first 2,500 m3) the cost of water represents a tiny percentage of the value of the crop (A citrus farmer using 1000 m3 per year spends 8 JD per dunum for water, barely 1.6 percent of an

estimated revenue of about 500 JD). Investments in water-saving methods and equipment will not pay off at those rates.

18.- In the highlands, by contrast, where farmers pump water from deep underground, the authorities reportedly allow farmers to pump up to a certain volume at no charge, but additional water beyond that threshold carries a charge of 350 fils per m3; as a result, highland farmers are more mindful in their water use. KAFA'A and JVA might explore the possible adoption of a similar structure of water rates for farms in the Jordan Valley. Such dual rate schedule (low rate for base volume and high rate for extra water) could encourage Jordan Valley farmers to economize water without increasing actual payments for water.

Table 1-a. Water Delivery Schedule of the Jordan Valley Authority for the North Jordan Valley. 2003-2004 North Area / Development Areas 1 to 21 and 33 to 39

<table>
<tr><td colspan="6">Water supply schedule for agricultural units in North Area during different months of year according to crop type.</td></tr>
<tr><td colspan="2">Bananas</td><td colspan="2">Citrus</td><td colspan="2">Vegetables</td></tr>
<tr><td>Period
(Date)</td><td>Daily Requirement m^3 / Dunum</td><td>Period
(Date)</td><td>Daily Requirements
m^3 / Dunum</td><td>Period
(Date)</td><td>Daily Requirement m^3 / Dunum</td></tr>
<tr><td>1/4 - 30/4</td><td>3</td><td>1/4 - 30/4</td><td>2</td><td>Spring period
1/2 - 15 /3</td><td>1</td></tr>
<tr><td>1/5 - 15/6</td><td>5</td><td>1/5 - 15/6</td><td>3</td><td>16/3 - 15/4</td><td>1.5</td></tr>
<tr><td>16/6 – 15/9</td><td>7</td><td>16/6 - 15/9</td><td>4</td><td>16/4 - 15/6</td><td>2</td></tr>
<tr><td>16/9 – 31/10</td><td>5</td><td>16/9 - 31/10</td><td>3</td><td>16/6 - 15/8</td><td>Irrigation water no more than 1 m^3 /day / dunum for summer agriculture</td></tr>
<tr><td rowspan="4">1/11 – 31/3</td><td rowspan="4">Irrigation water apply according to daily net requirement equation not more than
3 m^3 / day /dunum</td><td rowspan="4">1/11 - 31/3</td><td rowspan="4">Irrigation water apply according to daily net requirement equation not more than
2 m^3 / day /dunum</td><td>Autumn period
16/8 – 15/9</td><td>1</td></tr>
<tr><td>16/9 – 15/10</td><td>1.5</td></tr>
<tr><td>16/10 – 15/12</td><td>2</td></tr>
<tr><td>16/12 – 30/1</td><td>1</td></tr>
</table>

Note: added (10) % from above quantity for leaching

Table 1 - b . Water Delivery Schedule of the Jordan Valley Authority for the Center Jordan Valley. 2003-2004. Center Development Areas 22 to 32 and 53, 54

Water supply schedule for agricultural units in Center Area during different months of year according to crop type.					
Bananas		**Citrus**		**Vegetables**	
Period (Date)	Daily Requirement m^3 / Dunum	Period (Date)	Daily Requirements m^3 / Dunum	Period (Date)	Daily Requirement m^3 / Dunum
1/4 – 30/4	4	1/4 - 30/4	3	Spring period 15/2 - 15 / 3	1
1/5 – 15/6	6	1/5 - 15/6	4	16/10 - 30/11	1.5
16/6 - 15/9	8	16/6 - 15/9	5	1/12 - 15/5	2
16/9 - 31/10	6	16/9 - 31/10	4	16/5 - 15/6	1
1/11 - 31/3	Irrigation water apply according to daily net requirement equation not more 3 m^3 / day /dunum	1/11 - 31/3	Irrigation water apply according to daily net requirement equation not more 2 m^3 / day /dunum	15/6 - 1/9	Irrigation water no more than 1 m^3 /day / dunum for summer agriculture

Note: added (20) % from above quantity for leaching

Table 1 - c. Water Delivery Schedule of the Jordan Valley Authority for the South Jordan Valley. 2003-2004. South Area / Development Areas 40 to 48

Water supply schedule for to agricultural Units in South Area during different months of year according to crop type.					
Bananas		**Citrus**		**Vegetables**	
Period (Date)	Daily Requirement m^3 / Dunum	Period (Date)	Daily Requirements m^3 / Dunum	Period (Date)	Daily Requirement m^3 / Dunum
1/4 - 30/4	4	1/4 - 30/4	3	Spring period 15/9 - 15 /10	1
1/5 - 15/6	6	1/5 - 15/6	4	16/10 - 15/11	1.5
16/6 - 15/9	8	16/6 - 15/9	5	16/11 - 15/2	2
16/9 - 31/10	6	16/9 - 31/10	4	16/2 - 15/4	1.5
1/11 - 31/3	Irrigation water apply according to daily net requirement equation not more than 3 m^3 / day /dunum	1/11 - 31/3	Irrigation water apply according to daily net requirement equation not more than 3 m^3 / day /dunum	15/4 - 15/9	Irrigation water no more than 1 m^3 /day / dunum for summer agriculture

Note: added (10) % from above quantity for leaching

Table 1 – d. Jordan Water Delibery Schedules as Estimates of Crop Water needs, 2003-2004.

Table 1 - d. Jordan Valley Water Delivery Schedule as Estimates of Crop Water Needs, 2003-2004

North	Bananas	Citrus	Vegetables	Center	Bananas	Citrus	Vegetables	South	Bananas	Citrus	Vegetables
Feb	3	2	1.0	Feb	3	2	2.0	Feb	3	2	2.0
	3	2	1.0		3	2	2.0		3	2	1.5
Mar	3	2	1.0	Mar	3	2	2.0	Mar	3	2	1.5
	3	2	1.5		3	2	2.0		3	2	1.5
Apr	3	2	1.5	Apr	4	3	2.0	Apr	4	3	1.5
	3	2	2.0		4	3	2.0		4	3	1.0
May	5	3	2.0	May	6	4	2.0	May	6	4	1.0
	5	3	2.0		6	4	1.0		6	4	1.0
Jun	5	3	2.0	Jun	6	4	1.0	Jun	6	4	1.0
	7	4	1.0		8	5	1.0		8	5	1.0
Jul	7	4	1.0	Jul	8	5	1.0	Jul	8	5	1.0
	7	4	1.0		8	5	1.0		8	5	1.0
Aug	7	4	1.0	Aug	8	5	1.0	Aug	8	5	1.0
	7	4	1.0		8	5	1.0		8	5	1.0
Sep	7	4	1.0	Sep	8	5	1.0	Sep	8	5	1.0
	5	3	1.5		6	4	1.0		6	4	1.0
Oct	5	3	1.5	Oct	6	4	1.0	Oct	6	4	1.0
	5	3	2.0		6	4	1.5		6	4	1.5
Nov	3	2	2.0	Nov	3	2	1.5	Nov	3	2	1.5
	3	2	2.0		3	2	1.5		3	2	2.0
Dec	3	2	2.0	Dec	3	2	2.0	Dec	3	2	2.0
	3	2	1.0		3	2	2.0		3	2	2.0
Jan	3	2	1.0	Jan	3	2	2.0	Jan	3	2	2.0
	3	2	1.0		3	2	2.0		3	2	2.0

Source: JVA Water Delivery Schedule tables

North	O	N	D	J	F	M	A	M	J	J	A	S
Bananas	5.00	3.00	3.00	3.00	3.00	3.00	3.00	5.00	6.00	7.00	7.00	6.00
Citrus	5.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.50	4.00	4.00	3.50
Vegetables	1.75	2.00	1.50	1.00	1.00	1.25	1.75	2.00	1.50	1.00	1.00	1.25

Center	O	N	D	J	F	M	A	M	J	J	A	S
Bananas	6.00	3.00	3.00	3.00	3.00	3.00	4.00	6.00	7.00	8.00	8.00	7.00
Citrus	4.00	2.00	2.00	2.00	2.00	2.00	3.00	4.00	4.50	5.00	5.00	4.50
Vegetables	1.25	1.50	2.00	2.00	2.00	2.00	2.00	1.50	1.00	1.00	1.00	1.00

South	O	N	D	J	F	M	A	M	J	J	A	S
Bananas	6.00	3.00	3.00	3.00	3.00	3.00	4.00	6.00	7.00	8.00	8.00	7.00
Citrus	4.00	2.00	2.00	2.00	2.00	2.00	3.00	4.00	4.50	5.00	5.00	4.50
Vegetables	1.25	1.75	2.00	2.00	1.75	1.50	1.25	1.00	1.00	1.00	1.00	1.00

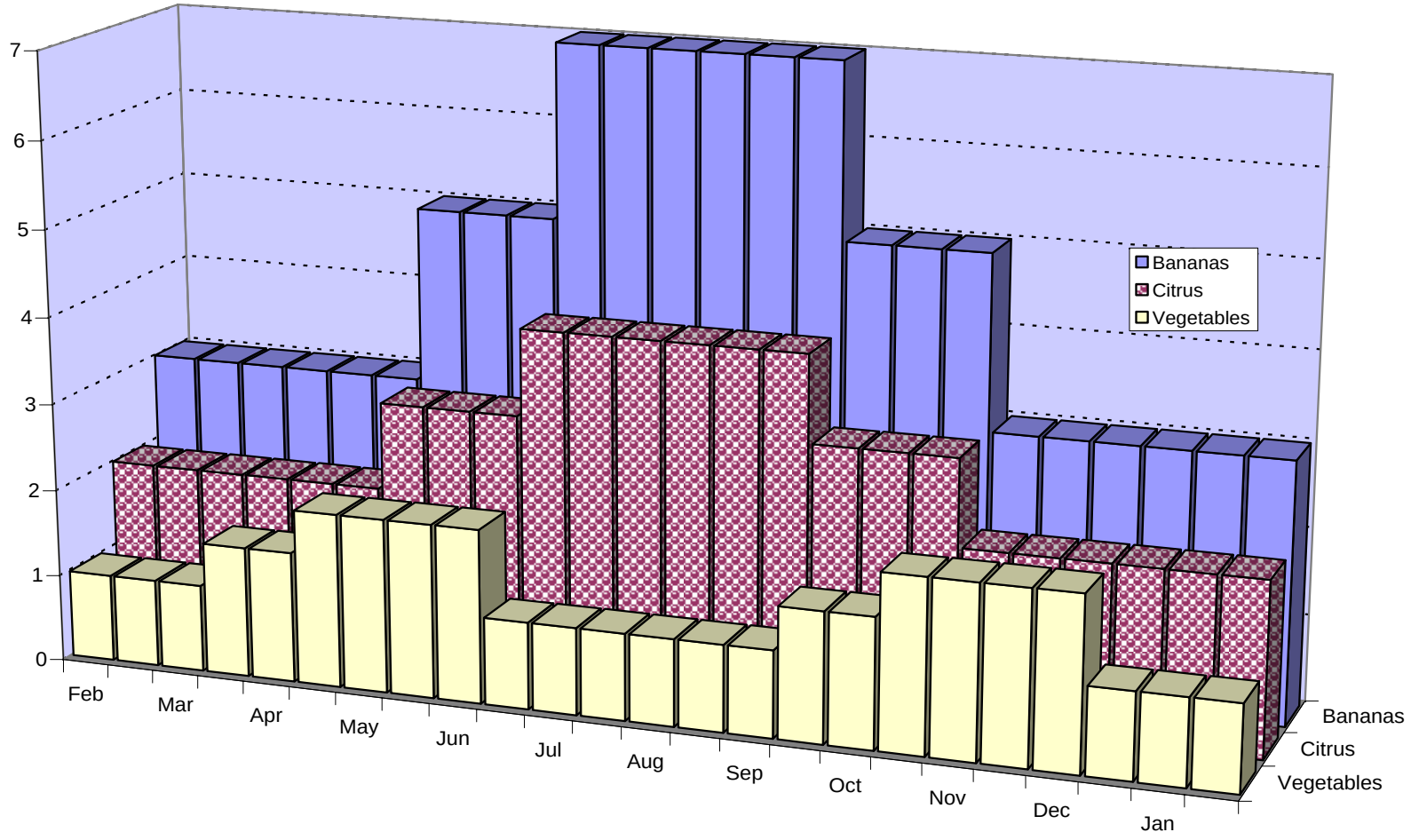


Figure 1 a. JVA Estimates of water needs and water delivery for North Jordan Valley, 2003-2004 (cubic meters per day per dunum). [See Table 1]

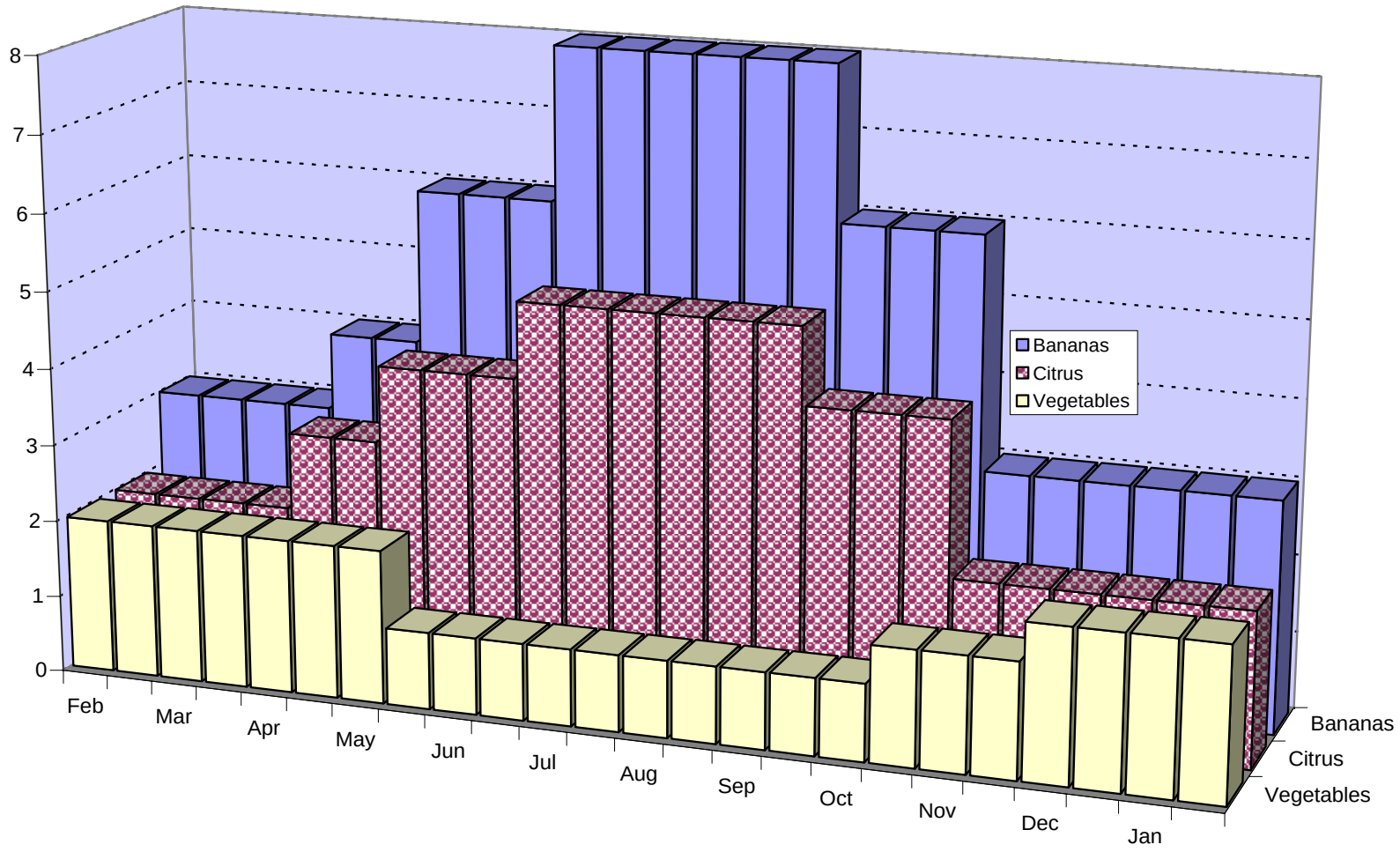


Figure 1 b. JVA Estimate of Water Needs and Water Delivery Schedule for the Center Jordan Valley, 2003-2004. (cubic meters per day per dunum)

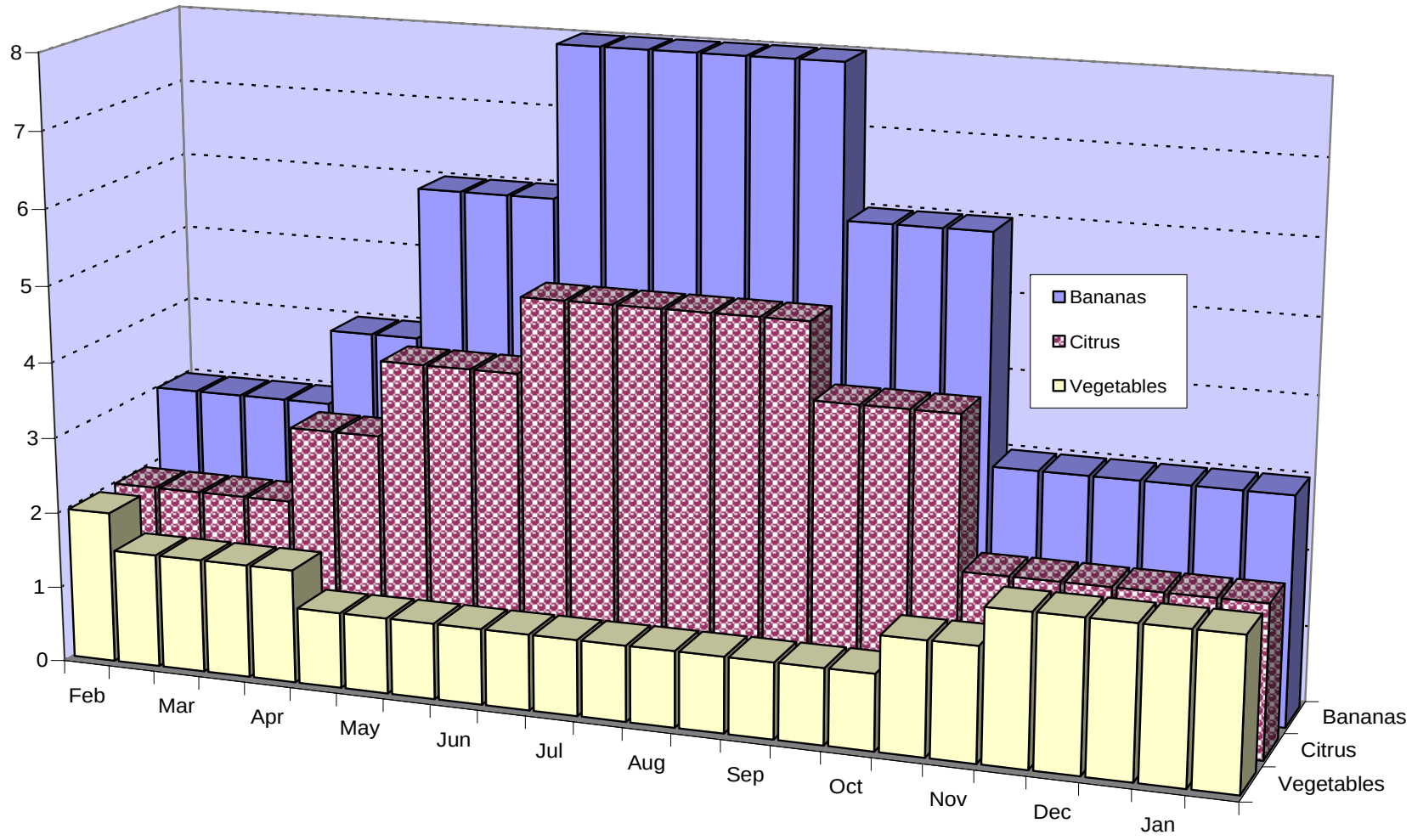


Figure 1 c. JVA Estimate of Water Needs and Delivery Schedule for South Jordan Valley. 2003-2004. (cubic meters per day per dunum)

Table 2 – a. Estimated Crop Water Needs in North, Center, and South Jordan Valley. (cubic meters per dunum per day).

Table 2-a. Estimated Crop Water Needs in North, Center, and South Jordan Valley. (cubic meters per dunum per day)										
North				Center				South		
Month	Bananas	Citrus	Vegetables	Month	Bananas	Citrus	Vegetables	Month	Bananas	Citrus	Vegetables
Feb	3	2	2.0	Feb	3	2	2.0	Feb	3	2	2.0
	3	2	2.0		3	2	2.0		3	2	2.0
Mar	3	2	2.0	Mar	3	2	2.0	Mar	3	2	2.0
	3	2	2.0		3	2	2.0		3	2	2.0
Apr	3	2	2.0	Apr	4	3	2.0	Apr	4	3	2.0
	3	2	2.0		4	3	2.0		4	3	2.0
May	5	3	2.0	May	6	4	2.0	May	6	4	2.0
	5	3	2.0		6	4	2.0		6	4	2.0
Jun	5	3	2.0	Jun	6	4	2.0	Jun	6	4	2.0
	7	4	3.0		8	5	3.0		8	5	3.0
Jul	7	4	3.0	Jul	8	5	3.0	Jul	8	5	3.0
	7	4	3.0		8	5	3.0		8	5	3.0
Aug	7	4	3.0	Aug	8	5	3.0	Aug	8	5	3.0
	7	4	3.0		8	5	3.0		8	5	3.0
Sep	7	4	3.0	Sep	8	5	3.0	Sep	8	5	3.0
	5	3	2.0		6	4	2.0		6	4	2.0
Oct	5	3	2.0	Oct	6	4	2.0	Oct	6	4	2.0
	5	3	2.0		6	4	2.0		6	4	2.0
Nov	3	2	2.0	Nov	3	2	2.0	Nov	3	2	2.0
	3	2	2.0		3	2	2.0		3	2	2.0
Dec	3	2	2.0	Dec	3	2	2.0	Dec	3	2	2.0
	3	2	2.0		3	2	2.0		3	2	2.0
Jan	3	2	2.0	Jan	3	2	2.0	Jan	3	2	2.0
	3	2	2.0		3	2	2.0		3	2	2.0

North	J	F	M	A	M	J	J	A	S	O	N	D
Bananas	3.00	3.00	3.00	3.00	5.00	6.00	7.00	7.00	6.00	5.00	3.00	3.00
Citrus	2.00	2.00	2.00	2.00	3.00	3.50	4.00	4.00	3.50	3.00	2.00	2.00
Vegetable	2.00	2.00	2.00	2.00	2.00	2.50	3.00	3.00	2.50	2.00	2.00	2.00

Center	J	F	M	A	M	J	J	A	S	O	N	D
Bananas	3.00	3.00	3.00	4.00	6.00	7.00	8.00	8.00	7.00	6.00	3.00	3.00
Citrus	2.00	2.00	2.00	3.00	4.00	4.50	5.00	5.00	4.50	4.00	2.00	2.00
Vegetable	2.00	2.00	2.00	2.00	2.00	2.50	3.00	3.00	2.50	2.00	2.00	2.00

South	J	F	M	A	M	J	J	A	S	O	N	D
Bananas	3.00	3.00	3.00	4.00	6.00	7.00	8.00	8.00	7.00	6.00	3.00	3.00
Citrus	2.00	2.00	2.00	3.00	4.00	4.50	5.00	5.00	4.50	4.00	2.00	2.00
Vegetable	2.00	2.00	2.00	2.00	2.00	2.50	3.00	3.00	2.50	2.00	2.00	2.00

Table 2 – b. Effective Monthly Precipitation for plant growth in the North, Center, and South Zones of the Jordan Valley. Year Average over 20 years.

Table 2b. Effective Monthly Precipitation for plant growth in the North, Center, and South Zones of the Jordan Valley. Year Average over 20 years.

millimeters of rain

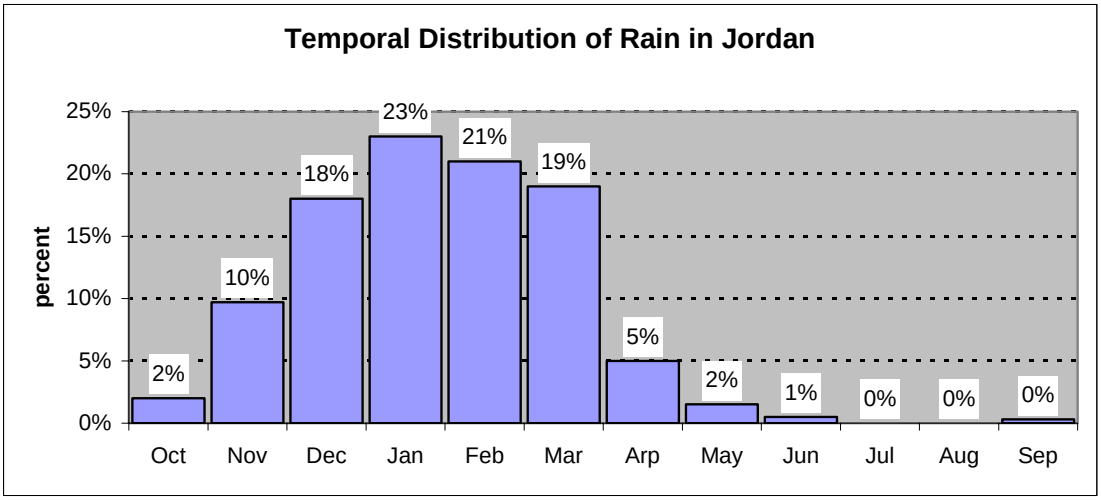
Zone	Year Avg.	Oct	Nov	Dec	Jan	Feb	Mar	Arp	May	Jun	Jul	Aug	Sep	Sum
North	252	5	24	45	58	53	48	13	4	1	-	-	1	252
Center	222	4	22	40	51	47	42	11	3	1	-	-	1	222
South	57	1	6	10	13	12	11	3	1	0	-	-	0	57

Source: Meteorological Information data for a 20-years series.

Temporal distribution of rainfall in Jordan (preliminary estimates)

Zone	Oct	Nov	Dec	Jan	Feb	Mar	Arp	May	Jun	Jul	Aug	Sep	Sum
North	0.02	0.097	0.18	0.23	0.21	0.19	0.05	0.015	0.005	0	0	0.003	100%
Center	0.02	0.097	0.18	0.23	0.21	0.19	0.05	0.015	0.005	0	0	0.003	100%
South	0.02	0.097	0.18	0.23	0.21	0.19	0.05	0.015	0.005	0	0	0.003	100%

Source: Jordan Meteorological Department (as printed in article by Sahar Aloul in The Jordan Times, Monday, November 8, 2004.



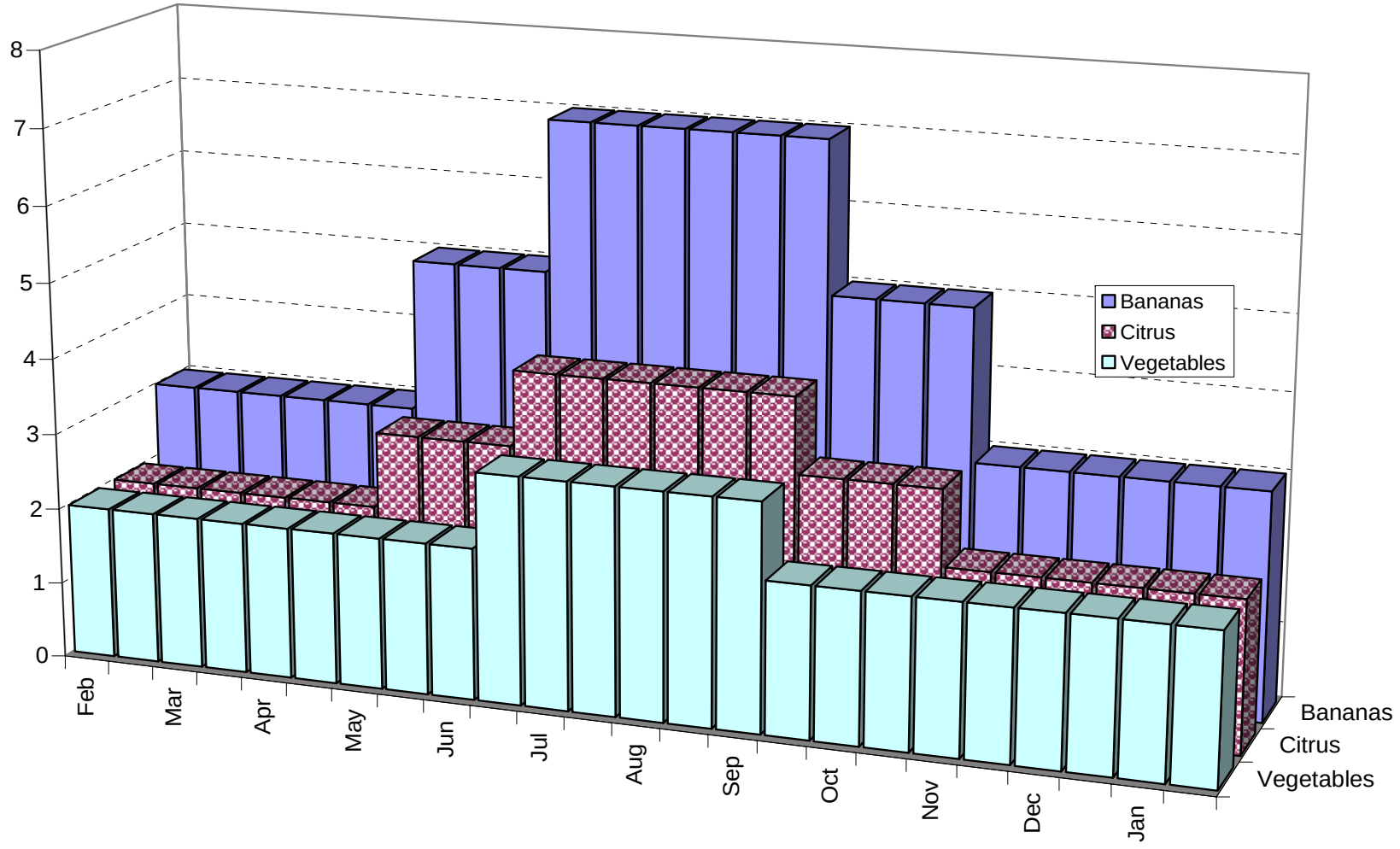


Figure 2 a. Water Needs Estimates by crop category, for North Jordan Valley. (cubic meters per day per dunum) [See Table 2]

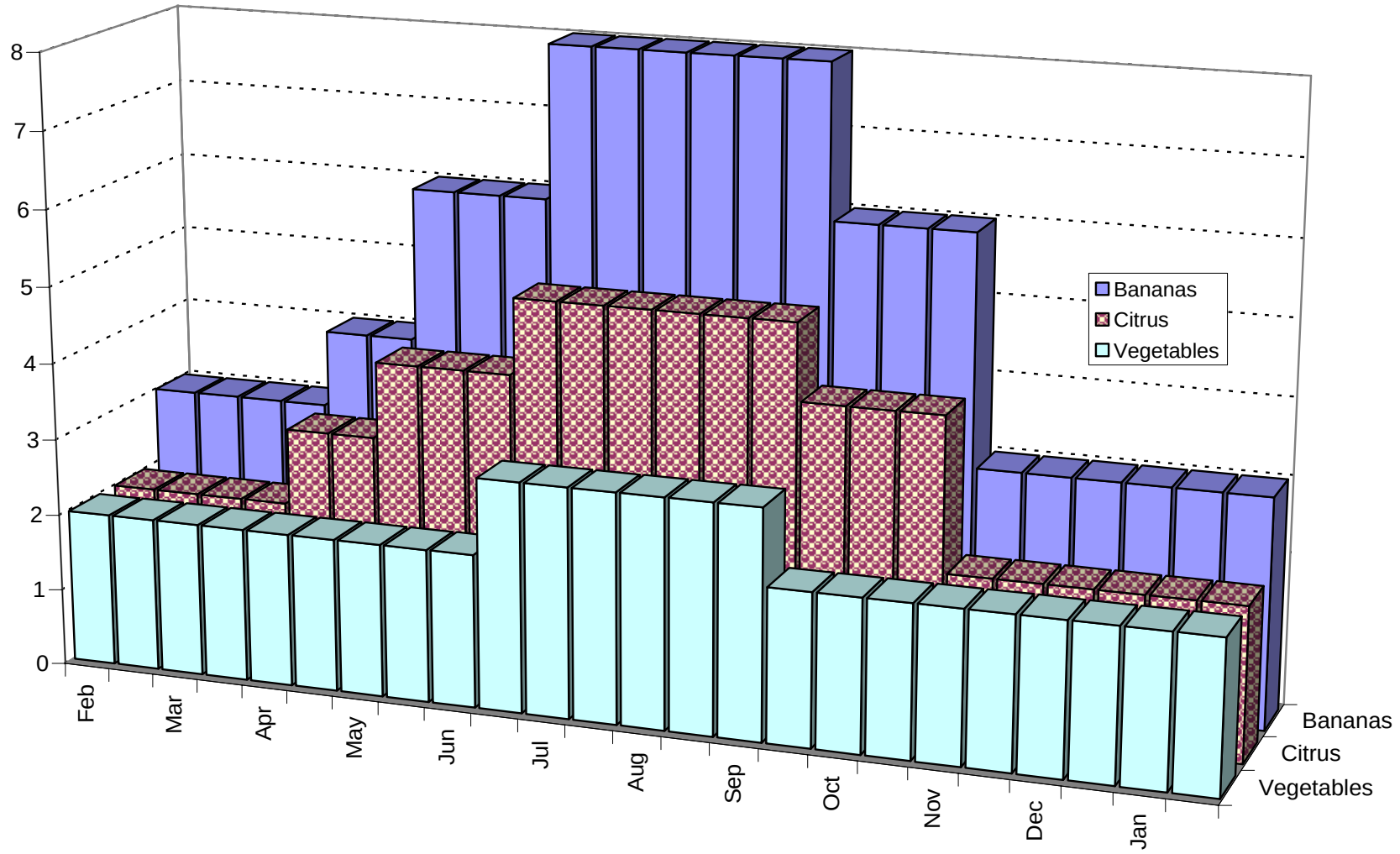


Figure 2 b. Water Needs Estimates by crop category, Center Jordan Valley. (cubic meters per donum per day)

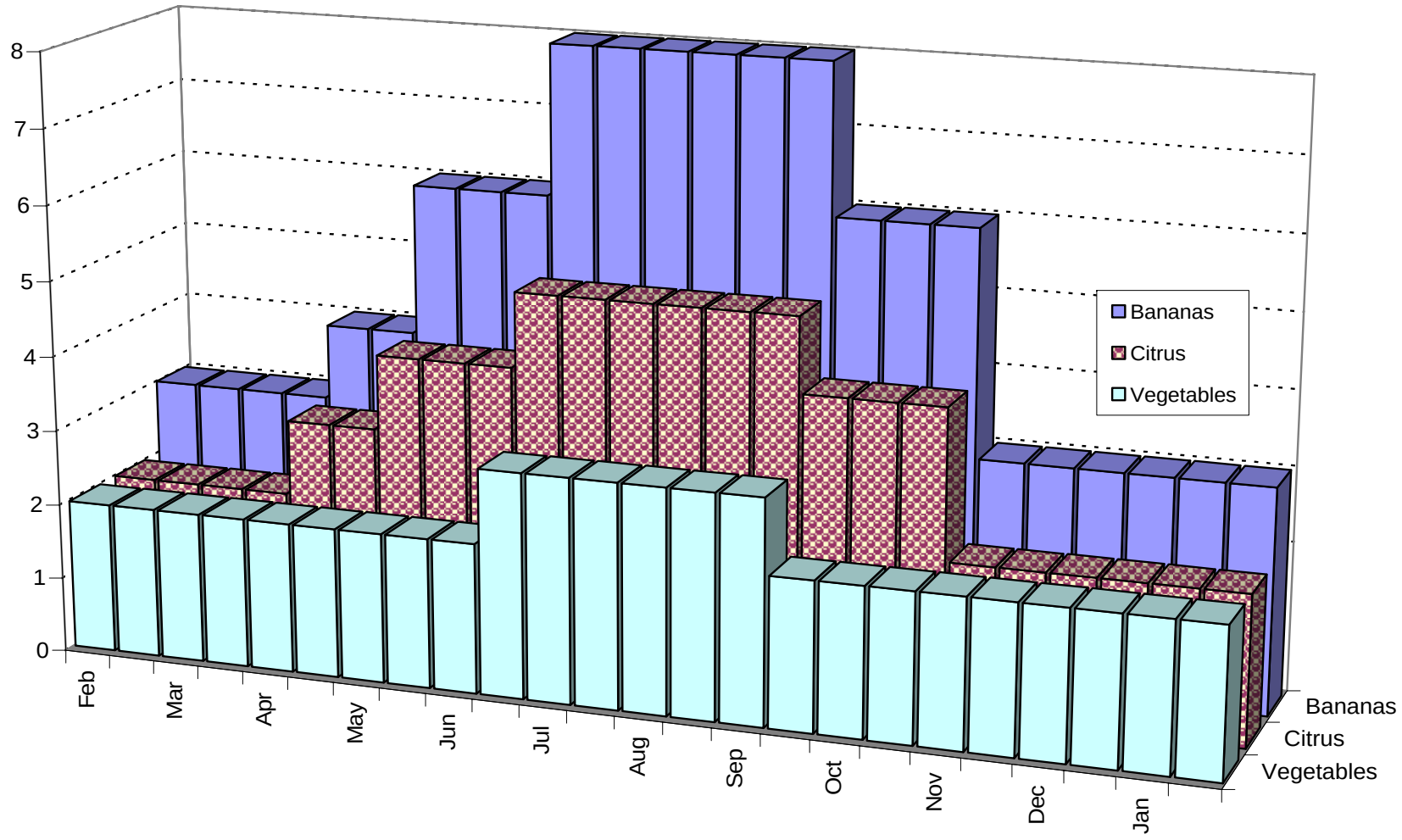


Figure 2 c. Water Needs Estimates by crop category, for South Jordan Valley (cubic meters per dunum)

Table 3 – a. Irrigation Water Needs for Selected Crops in the North Jordan Valley.

Table 3 a. Irrigationn Water Needs for Selected Crops in the North Jordan Valley													
Crop	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
Maize	56	-	-	-	-	-	-	57	75	91	91	75	445
Sorghum	56	-	-	-	-	-	-	57	75	91	91	75	445
Wheat	-	-	15	3	8	13	48	-	-	-	-	-	87
Barley	-	-	15	3	8	13	48	-	-	-	-	-	87
Berseem	56	36	15	3	8	13	48	-	-	-	-	-	179
Tomato I (Fall)	56	36	15	-	-	-	-	-	-	-	91	75	274
Tomato IB (Fall 2)	56	36	15	3	8	-	-	-	-	-	-	75	194
Tomato III (Spr)	-	-	-	-	8	13	48	57	75	-	-	-	201
Tomato III B (Win)	-	-	15	3	8	13	48	57	-	-	-	-	144
G.H. tomato I (aut)	61	61	61	-	-	-	-	-	-	-	91	76	350
G.H. tomato II (win)	61	61	61	61	61	61	61	61	-	-	-	-	486
G.H. tomato III(spr)	-	-	-	-	61	61	61	61	76	-	-	-	319
Potato I (aut)	56	36	15	-	-	-	-	-	-	-	-	75	183
Potato II (spr)	-	-	-	3	8	13	48	57	-	-	-	-	129
Tunnel cucumber I	-	36	15	3	8	13	-	-	-	-	-	-	75
Tunnel cucumber II	56	36	15	-	-	-	-	-	-	-	-	75	183
G.H. cucumber	61	61	61	61	61	61	61	-	-	-	-	-	426
Lettuce I (aut)	56	36	15	-	-	-	-	-	-	-	-	75	183
Lettuce II (win)	-	36	15	3	8	-	-	-	-	-	-	-	63
Squash I (aut2)	56	36	15	-	-	-	-	-	-	-	-	75	183
Squash II (win)	-	36	15	3	8	-	-	-	-	-	-	-	63
Squash III (spr)	-	-	-	-	8	13	48	57	75	-	-	-	201
Squash IV (aut 1)	56	36	-	-	-	-	-	-	-	-	91	75	259
Watermelon	-	-	-	-	8	13	48	57	75	91	-	-	292
Cabbage I (aut)	56	36	15	-	-	-	-	-	-	-	-	75	183
Cabbage II (win)	-	36	15	3	8	13	-	-	-	-	-	-	75
Cabbage III (spr)	-	-	-	-	8	13	48	57	75	-	-	-	201
Cauliflower I (aut)	56	36	15	-	-	-	-	-	-	-	-	75	183
Cauliflower II (win)	-	36	15	3	8	13	-	-	-	-	-	-	75
Green Beans I (aut)	56	36	-	-	-	-	-	-	-	-	-	75	167
Green Beans II (spr2)	-	-	-	-	8	13	48	57	-	-	-	-	126
Green Beans III (win)	-	36	15	3	8	-	-	-	-	-	-	-	63
Green Beans IV (spr1)	-	-	-	3	8	13	48	-	-	-	-	-	72
Broad Beans - Other veg	56	36	15	3	-	-	-	-	-	-	-	75	186
Onion	56	36	15	3	8	13	48	57	-	-	-	75	312
Eggplant I (aut)	56	36	15	-	-	-	-	-	-	-	91	75	274
Eggplant II (spr)	-	-	-	3	8	13	48	57	75	-	-	-	204
Eggplant III (win)	-	36	15	3	8	13	48	-	-	-	-	-	124
Pepper I (aut)	56	36	15	-	-	-	-	-	-	-	91	75	274
Pepper II (spr)	-	-	-	3	8	13	48	57	75	-	-	-	204
Pepper III (win)	-	36	15	3	8	13	48	-	-	-	-	-	124
Banana	147	67	46	33	38	43	79	148	181	213	213	182	1,390
Citrus	86	36	15	3	8	13	48	87	105	122	122	106	751

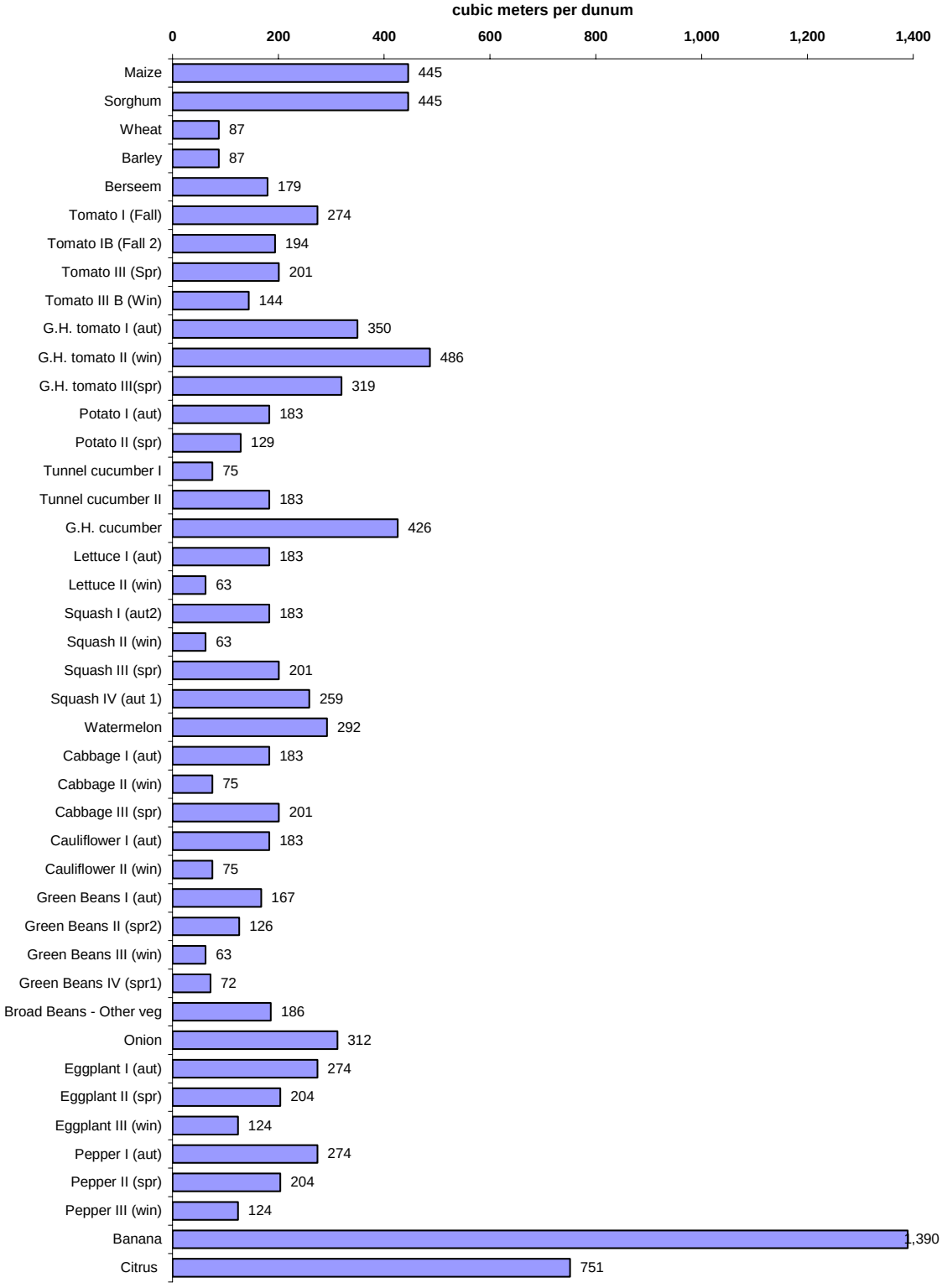


Figure 3 a. Crop Water Requirements for selected crops in the North Jordan Valley
Table 3 – b. Irrigation Water Needs for Selected Crops in the Center Jordan Valley.

Table 3 b. Irrigation Water Needs for Selected Crops in the Center Jordan Valley													
Crop	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
Maize	56							57	75	91	91	75	446
Sorghum	56							57	75	91	91	75	446
Wheat			21	10	14	19	50						113
Barley			21	10	14	19	50						113
Berseem	56	39	21	10	14	19	50						209
Tomato I (Fall)	56	39	21								91	75	283
Tomato IB (Fall 2)	56	39	21	10								75	202
Tomato III (Spr)					14	19	50	57	75				215
Tomato III B (Win)			21	10	14	19	50	57					171
G.H. tomato I (aut)	61	61	61								91	76	350
G.H. tomato II (win)	61	61	61	61	61	61	61	61					486
G.H. tomato III(spr)					61	61	61	61	76				319
Potato I (aut)	56	39	21									75	192
Potato II (spr)					14	19	50	57					140
Tunnel cucumber I		39	21	10	14								84
Tunnel cucumber II	56	39	21									75	192
G.H. cucumber	61	61	61	61	61	61	61						426
Lettuce I (aut)	56	39	21									75	192
Lettuce II (win)		39	21	10	14								84
Squash I (aut2)	56	39	21									75	192
Squash II (win)		39	21	10	14								84
Squash III (spr)					14	19	50	57	75				215
Squash IV (aut 1)	56	39									91	75	262
Watermelon					14	19	50	57	75	91			306
Cabbage I (aut)	56	39	21									75	192
Cabbage II (win)		39	21	10	14								84
Cabbage III (spr)					14	19	50	57	75				215
Cauliflower I (aut)	56	39	21									75	192
Cauliflower II (win)		39	21	10	14	19							103
Green Beans I (aut)	56	39										75	171
Green Beans II (spr2)					14	19	50	57					140
Green Beans III (win)		39	21	10									70
Green Beans IV (spr1)					14	19	50						83
Broad Beans - Other veg	56	39	21	10								75	202
Onion	56	39	21	10	14	19	50	57				75	342
Eggplant I (aut)	56	39	21								91	75	283
Eggplant II (spr)					14	19	50	57	75				215
Eggplant III (win)		39	21	10	14	19	50						152
Pepper I (aut)	56	39	21								91	75	283
Pepper II (spr)					14	19	50	57	75				215
Pepper III (win)		39	21	10	14	19	50						152
Banana	178	70	51	40	45	49	111	179	212	243	243	212	1,632
Citrus	117	39	21	10	14	19	80	118	136	152	152	136	994

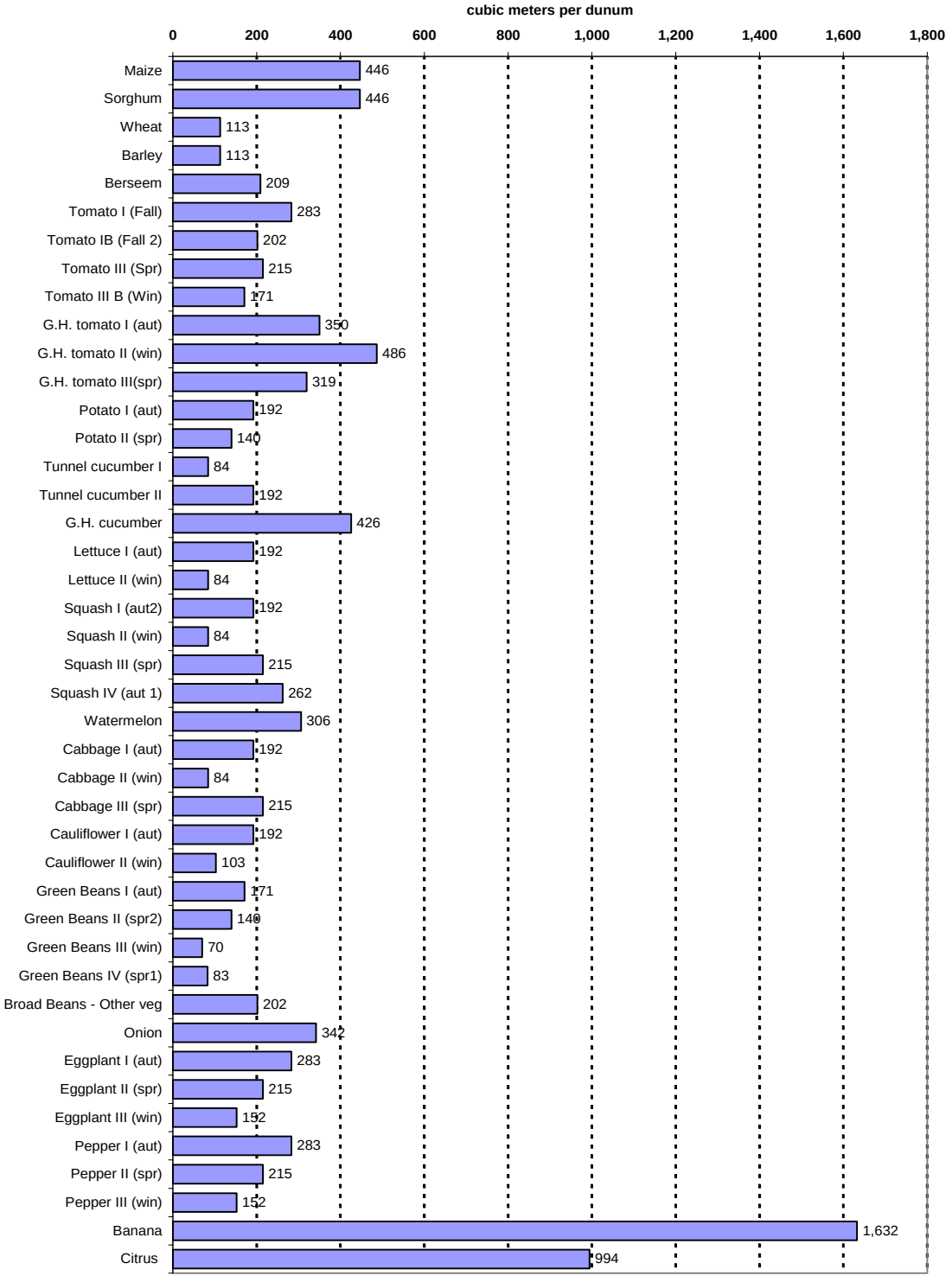


Figure 3 b. Crop Water Requirements for selected crops in the Center Jordan Valley

Table 3 – c. Irrigation Water Needs for Selected Crops in the South Jordan Valley.

Table 3 c. Irrigation Water Needs for Selected Crops in the South Jordan Valley													
Crop	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
Maize	60							60	76	91	91	76	454
Sorghum	60							60	76	91	91	76	454
Wheat			51	48	49	50	58						255
Barley			51	48	49	50	58						255
Berseem	60	55	51	48	49	50	58						370
Tomato I (Fall)	60	55	51								91	76	333
Tomato IB (Fall 2)	60	55	51	48	49							76	338
Tomato III (Spr)					49	50	58	60	76				292
Tomato III B (Win)			51	48	49	50	58	60					315
G.H. tomato I (aut)	61	61	61	61							91	76	410
G.H. tomato II (win)	61	61	61	61	61	61	61	61					486
G.H. tomato III(spr)				61	61	61	61	61	76				380
Potato I (aut)	60	55	51									76	241
Potato II (spr)				48	49	50	58	60					264
Tunnel cucumber I		55	51	48	49	50							252
Tunnel cucumber II	60	55	51									76	241
G.H. cucumber	61	61	61	61	61	61	61						426
Lettuce I (aut)	60	55	51									76	241
Lettuce II (win)		55	51	48	49								202
Squash I (aut2)	60	55	51									76	241
Squash II (win)		55	51	48	49	50							252
Squash III (spr)					49	50	58	60	76				292
Squash IV (aut 1)	60	55									91	76	282
Watermelon					49	50	58	60	76	91			384
Cabbage I (aut)	60	55	51									76	241
Cabbage II (win)		55	51	48	49	50							252
Cabbage III (spr)					49	50	58	60	76				292
Cauliflower I (aut)	60	55	51									76	241
Cauliflower II (win)		55	51	48	49	50							252
Green Beans I (aut)	60	55										76	191
Green Beans II (spr2)					49	50	58	60					217
Green Beans III (win)		55	51	48	49								202
Green Beans IV (spr1)				48	49	50	58						204
Broad Beans - Other veg	60	55	51	48								76	289
Onion	60	55	51	48	49	50	58	60				76	506
Eggplant I (aut)	60	55	51								91	76	333
Eggplant II (spr)				48	49	50	58	60	76				340
Eggplant III (win)		55	51	48	49	50	58						310
Pepper I (aut)	60	55	51	48							91	76	380
Pepper II (spr)				48	49	50	58	60	76				340
Pepper III (win)		55	51	48	49	50	58						310
Banana	181	86	81	78	79	80	119	182	213	243	243	213	1,797
Citrus	120	55	51	48	49	50	88	121	137	152	152	137	1,159

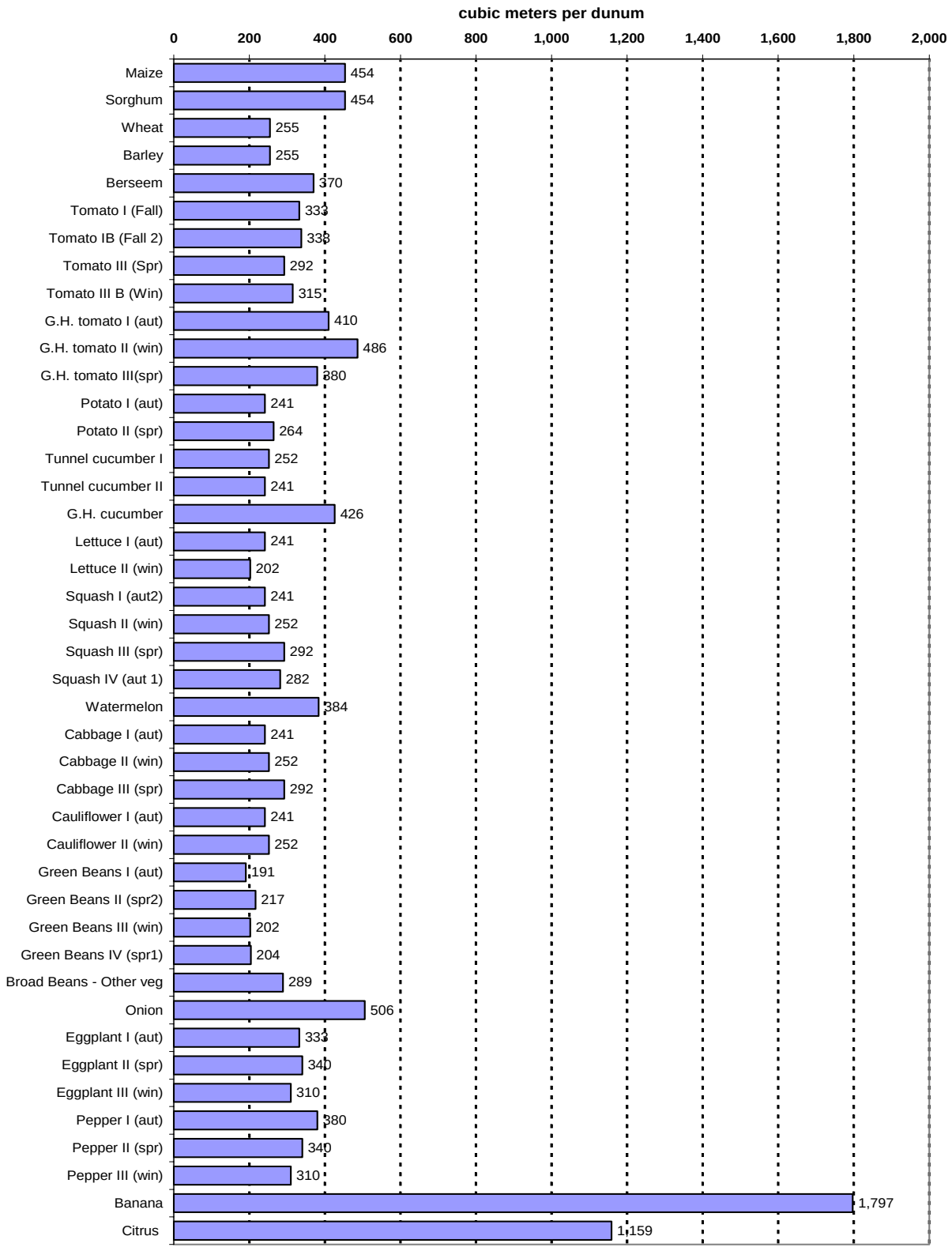


Figure 3 c. Crop Water Requirements for selected crops in the South Jordan Valley

Table 4. Estimated Crop Water Needs for North, Center and South Zones in the Jordan Valley. 2003-2004. (cubic meters per dunum per month).

Table 4. Estimated Crop Water Needs for North, Center, and South Zones in the Jordan Valley. 2002-2003. (cubic meters per dunum per moth)

Zone	Crop	Farm	Crop name	Water	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	63	1	POMEGRANATE	751	86	36	15	3	8	13	48	87	105	122	122	106
1	64	1	POTATO	156	28	18	8	1	4	6	24	29	-	-	-	38
1	65	1	PUMMELOR	751	86	36	15	3	8	13	48	87	105	122	122	106
1	66	1	PUMPKIN	292	-	-	-	-	8	13	48	57	75	91	-	-
1	67	1	RADISH	156	28	18	8	1	4	6	24	29	-	-	-	38
1	68	1	SAGE													
1	69	1	SESAME													
1	70	1	SILQ	186	56	36	15	3	-	-	-	-	-	-	-	75
1	71	1	SNAKE CUCUMBER	228	39	45	31	21	23	25	20	-	-	-	-	25
1	72	1	SORGHUM	445	56	-	-	-	-	-	-	57	75	91	91	75
1	73	1	SPINACH	186	56	36	15	3	-	-	-	-	-	-	-	75
1	74	1	SQUASH	176	28	27	8	1	4	3	12	14	19	-	23	38
1	75	1	STRAWBERRY													
1	76	1	STRING BEANS	186	56	36	15	3	-	-	-	-	-	-	-	75
1	77	1	SWEET PEPPER	200	19	24	10	2	5	9	32	19	25	-	30	25
1	78	1	THYME													
1	79	1	TOBACCO													
1	80	1	TOMATO	203	28	18	12	1	6	6	24	29	19	-	23	38
1	80	2	TOMATO	385	41	41	41	20	41	41	41	41	25	-	30	25
1	80	3	TOMATO	385	41	41	41	20	41	41	41	41	25	-	30	25
1	80	4	TOMATO	385	41	41	41	20	41	41	41	41	25	-	30	25
1	81	1	TURNIP	156	28	18	8	1	4	6	24	29	-	-	-	38
1	82	1	VETCH													
1	83	1	WALNUT	751	86	36	15	3	8	13	48	87	105	122	122	106
1	84	1	FOREST TREES													
1	85	1	WHEAT	87	-	-	15	3	8	13	48	-	-	-	-	-
1	86	1	ZUCCHINI	176	28	27	8	1	4	3	12	14	19	-	23	38
1	87	1	Don't know													
1	88	1	BOMELY	751	86	36	15	3	8	13	48	87	105	122	122	106
1	89	1	SUNFLOWER													
1	90	1	WATER MELON	292	-	-	-	-	8	13	48	57	75	91	-	-
1	93	1	ORNEMENTALS	751	86	36	15	3	8	13	48	87	105	122	122	106
1	91	1	LENTIL													
1	92	1	LAQUOT													
2	1	1	ALFALFA													
2	2	1	ALMOND	994	117	39	21	10	14	19	80	118	136	152	152	136
2	3	1	APPLE	994	117	39	21	10	14	19	80	118	136	152	152	136
2	4	1	APRICOT	994	117	39	21	10	14	19	80	118	136	152	152	136
2	5	1	ARTICHOKE													
2	6	1	ASPARAGUS													
2	7	1	AVOCADO													
2	8	1	BANANA	1,632	178	70	51	40	45	49	111	179	212	243	243	212
2	9	1	BARLEY	113	-	-	21	10	14	19	50	-	-	-	-	-
2	10	1	BEET,RED													
2	11	1	BROAD BEANS, GRI	202	56	39	21	10	-	-	-	-	-	-	-	75
2	12	1	CABBAGE	164	19	26	14	3	9	6	17	19	25	-	-	25
2	13	1	CADUR FIG	994	117	39	21	10	14	19	80	118	136	152	152	136
2	14	1	CANTALOUPE	306	-	-	-	-	14	19	50	57	75	91	-	-
2	15	1	CARROT	166	28	20	10	-	7	9	25	29	-	-	-	38
2	16	1	CAULIFLOWER	147	28	39	21	5	7	9	-	-	-	-	-	38

Table 5. Partial Example of Area Planted, Value of Production, and Water Needs for each Crop in Survey Sample Farms in the Jordan Valley, 2002-2003.

Table 5. Partial Example of Area Planted, Value of Production, and Water Needs each Crop in Survey Sample Farms in the Jordan Valley, 2002-2003

DA	Zone	Farm Unit Code	Crop Group	Category	Crop Code	Farming Code	Crop name	Area du	Value Production /dn	Water	m3/du
1	North	380012	Bananas	B	8	1	BANANA	13	13,650	18,065	1,390
1	North	380012	Citrus	C	19	1	CLEMENTINE	6	1,080	4,507	751
1	North	380012	Citrus	C	42	1	MANDARIN	6	1,080	4,507	751
1	North	380017	Citrus	C	33	1	GRAPEFRUIT	1	210	751	751
1	North	380017	Citrus	C	51	1	ORANGE NAVEL	3	1,350	2,254	751
1	North	380017	Citrus	C	57	1	ORANGE, SOUR	4	1,120	3,005	751
1	North	380017	Citrus	C	58	1	ORANGE, VALENCIA	2	420	1,502	751
1	North	380017	Other Trees	T	32	1	GRAPE	1	80	751	751
1	North	380017	Other Trees	T	48	1	OLIVE	2	150	1,502	751
1	North	390009	Bananas	B	8	1	BANANA	18	81,000	25,013	1,390
1	North	390012	Bananas	B	8	1	BANANA	40	120,400	55,584	1,390
2	Central	190002	Vegetables	V	39	1	LETTUCE	5	3,000	690	138
2	Central	190002	Vegetables	V	47	1	OKRA	40	48,000	12,242	306
2	Central	190002	Vegetables	V	49	1	ONION, DRY	20	12,000	6,830	342
2	Central	190002	Vegetables	V	64	1	POTATO	40	37,200	6,635	166
2	Central	190002	Vegetables	V	77	1	SWEET PEPPER	5	5,500	1,084	217
2	Central	190002	Vegetables	V	86	1	ZUCCHINI	50	200,000	9,411	188
2	Central	190011	Vegetables	V	64	1	POTATO	35	17,850	5,806	166
2	Central	190011	Vegetables	V	80	1	TOMATO	35	12,600	7,612	217
2	Central	190015	Citrus	C	19	1	CLEMENTINE	15	4,500	14,910	994
2	Central	190015	Citrus	C	38	1	LEMON	8	2,400	7,952	994
2	Central	190015	Citrus	C	42	1	MANDARIN	10	3,000	9,940	994
2	Central	190015	Citrus	C	51	1	ORANGE NAVEL	5	30,000	4,970	994
2	Central	190016	Citrus	C	19	1	CLEMENTINE	5	1,250	4,970	994
2	Central	190016	Citrus	C	51	1	ORANGE NAVEL	5	2,500	4,970	994
2	Central	190026	Citrus	C	19	1	CLEMENTINE	7	3,500	6,958	994
2	Central	190026	Citrus	C	42	1	MANDARIN	7	2,450	6,958	994
2	Central	190026	Vegetables	V	47	1	OKRA	16	12,000	4,897	306
2	Central	190026	Vegetables	V	64	1	POTATO	16	14,400	2,654	166
2	Central	190041	Vegetables	V	80	3	TOMATO	36	124,200	13,862	385
2	Central	190054	Vegetables	V	25	3	CUCUMBER	26	78,000	11,066	426
2	Central	190054	Vegetables	V	80	3	TOMATO	20	58,800	7,701	385
2	Central	190082	Citrus	C	19	1	CLEMENTINE	12	4,320	11,928	994
2	Central	190082	Citrus	C	38	1	LEMON	7	6,125	6,958	994
2	Central	190082	Citrus	C	42	1	MANDARIN	12	8,640	11,928	994
2	Central	190082	Citrus	C	51	1	ORANGE NAVEL	1	625	994	994
2	Central	190088	Vegetables	V	35	1	HOT PEPPER	10	8,000	2,167	217
2	Central	190088	Vegetables	V	77	1	SWEET PEPPER	6	3,600	1,300	217
2	Central	190088	Vegetables	V	80	1	TOMATO	10	6,300	2,175	217
2	Central	190088	Vegetables	V	86	1	ZUCCHINI	6	360	1,129	188
2	Central	190092	Other Trees	T	48	1	OLIVE	6	450	5,964	994
2	Central	190092	Vegetables	V	9	1	BARLEY	6	162	678	113
2	Central	190092	Vegetables	V	47	1	OKRA	6	468	1,836	306
2	Central	200001	Vegetables	V	25	3	CUCUMBER	25	67,500	10,640	426
2	Central	200001	Vegetables	V	80	3	TOMATO	10	25,000	3,851	385
2	Central	200009	Vegetables	V	25	3	CUCUMBER	25	71,250	10,640	426
2	Central	200009	Vegetables	V	80	3	TOMATO	25	71,500	9,627	385
2	Central	200054	Vegetables	V	25	3	CUCUMBER	10	28,500	4,256	426
2	Central	200054	Vegetables	V	64	1	POTATO	8	3,600	1,327	166
2	Central	200054	Vegetables	V	80	1	TOMATO	10	2,800	2,175	217
2	Central	200054	Vegetables	V	80	3	TOMATO	5	10,500	1,925	385
2	Central	200069	Vegetables	V	76	1	STRING BEANS	10	1,250	2,015	202
2	Central	200069	Vegetables	V	80	1	TOMATO	25	10,000	5,437	217

Table 6. Value and Gross Revenue less Deductions for Initial Investment for Selected Crops in Jordan Valley. 2002-2003

Table 6. Value and Gross Revenue less Deductions for Initial Investment for Selected Crops in Jordan Valley. 200

Zone (All)

						per dunum			per 1000 m3	
Cat txt	**Crop name**	**Area**	**Value Pdn**	**Revenue**	**Water**	**Value Pdn**	**Revenue**	**Water**	**Value Pdn**	**Revenue**
Bananas		**394**	**408,325**	**374,645**	**569,931**	**1,036**	**951**	**1,447**	**716**	**657**
	BANANA	394	408,325	374,645	569,931	1,036	951	1,447	716	657
Citrus		**4,804**	**2,294,506**	**1,710,827**	**3,776,078**	**478**	**356**	**786**	**608**	**453**
	BOMELY	306	114,818	77,697	256,807	376	254	841	447	303
	CLEMENTINE	1,214	362,559	215,105	956,135	299	177	788	379	225
	GRAPEFRUIT	123	30,225	15,279	95,311	246	124	775	317	160
	LEMON	231	146,218	118,149	185,329	633	511	802	789	638
	MANDARIN	428	173,034	121,088	340,805	405	283	797	508	355
	ORANGE NAVEL	800	599,429	502,220	639,575	749	628	799	937	785
	ORANGE, FRENCH	56	28,798	21,993	42,553	514	393	760	677	517
	ORANGE, KING	18	4,546	2,359	13,522	253	131	751	336	174
	ORANGE, LOCAL	54	31,050	24,488	40,565	575	453	751	765	604
	ORANGE, RED	260	142,445	110,852	195,312	548	426	751	729	568
	ORANGE, SHAMOUTI	237	122,383	93,584	188,960	516	395	797	648	495
	ORANGE, SOUR	926	452,836	340,316	707,023	489	368	764	640	481
	ORANGE, VALENCIA	152	86,167	67,697	114,182	567	445	751	755	593
Other Trees		**434**	**123,328**	**70,592**	**390,635**	**284**	**163**	**900**	**316**	**181**
	APPLE	3	540	175	2,254	180	58	751	240	78
	DATE PALM	130	57,904	42,108	119,265	445	324	917	486	353
	GRAPE	65	19,188	11,289	67,568	295	174	1,040	284	167
	GUAVA	62	13,725	6,191	50,216	221	100	810	273	123
	OLIVE	127	22,596	7,164	116,026	178	56	914	195	62
	POMEGRANATE	47	9,375	3,664	35,306	199	78	751	266	104
Vegetables		**7,503**	**4,521,550**	**4,270,691**	**1,948,663**	**603**	**569**	**260**	**2,320**	**2,192**
	BARLEY	23	652	652	2,162	28	28	94	302	302
	BROAD BEANS, GREEN	188	44,748	44,748	42,787	238	238	228	1,046	1,046
	CABBAGE	97	35,973	35,973	17,356	371	371	179	2,073	2,073
	CARROT	90	78,004	78,004	14,847	872	872	166	5,254	5,254
	CAULIFLOWER	112	17,650	17,650	20,997	158	158	187	841	841
	CHICORY	2	50	50	578	25	25	289	87	87
	CLOVER TREFOIL	71	7,890	7,890	12,737	111	111	179	619	619
	CORIANDER	9	925	925	2,601	103	103	289	356	356
	COWPEAS	3	270	270	557	90	90	186	485	485
	CRESS	12	1,216	1,216	3,323	106	106	289	366	366
	CUCUMBER	573	1,074,890	933,910	234,823	1,877	1,631	410	4,577	3,977
	EGGPLANT	689	268,778	268,778	192,240	390	390	279	1,398	1,398
	FENNEL	4	1,000	1,000	1,156	250	250	289	865	865
	HOT PEPPER	203	66,344	66,344	60,855	327	327	300	1,090	1,090
	JEW'S MALLOW	87	15,105	15,105	13,427	174	174	154	1,125	1,125
	LETTUCE	187	27,570	27,570	37,078	147	147	198	744	744
	MAIZE	355	46,456	46,456	159,710	131	131	450	291	291
	MINT	11	3,870	3,870	3,179	352	352	289	1,217	1,217
	OKRA	229	97,648	97,648	71,850	426	426	314	1,359	1,359
	ONION, DRY	275	66,783	66,783	95,841	243	243	349	697	697
	PARSLEY	37	10,444	10,444	10,279	282	282	278	1,016	1,016
	PEAS	4	400	400	1,156	100	100	289	346	346
	POTATO	770	454,251	454,251	134,199	590	590	174	3,385	3,385
	PUMPKIN	4	1,000	1,000	1,534	250	250	384	652	652
	RADISH	14	2,490	2,490	2,570	178	178	184	969	969
	SILQ	2	56	56	433	38	38	289	130	130
	SNAKE CUCUMBER	11	1,260	1,260	2,572	115	115	234	490	490
	SPINACH	22	4,960	4,960	4,084	225	225	186	1,214	1,214
	SQUASH	66	31,250	31,250	17,622	473	473	267	1,773	1,773
	STRING BEANS	140	27,035	27,035	27,646	194	194	198	978	978
	SWEET PEPPER	44	13,900	13,900	9,128	316	316	207	1,523	1,523
	TOMATO	1,752	1,686,566	1,576,687	512,304	963	900	292	3,292	3,078
	TURNIP	2	400	400	332	200	200	166	1,206	1,206
	WHEAT	497	21,077	21,077	55,891	42	42	112	377	377
	ZUCCHINI	920	410,639	410,639	180,809	446	446	197	2,271	2,271
Grand Total		**13,134**	**7,347,708**	**6,426,754**	**6,685,307**	**559**	**489**	**509**	**1,099**	**961**

Table 7 – a. Cropping pattern among survey sample farms in the Jordan Valley, Season 2002-2003.

Table 7-a. Cropping pattern among survey sample farms in the Jordan Valley. Season 2002-2003

Zone	(All)

Sum of Area	Cat txt				
Crop name	Bananas	Citrus	Other Trees	Vegetables	Grand Total
APPLE			3		3
BANANA	394				394
BARLEY				23	23
BOMELY		305.5			305.5
BROAD BEANS, GREEN				188	188
CABBAGE				97	97
CARROT				89.5	89.5
CAULIFLOWER				112	112
CHICORY				2	2
CLEMENTINE		1213.5			1213.5
CLOVER TREFOIL				71	71
CORIANDER				9	9
COWPEAS				3	3
CRESS				11.5	11.5
CUCUMBER				572.7	572.7
DATE PALM			130		130
EGGPLANT				689	689
FENNEL				4	4
GRAPE			65		65
GRAPEFRUIT		123			123
GUAVA			62		62
HOT PEPPER				203	203
JEW'S MALLOW				87	87
LEMON		231			231
LETTUCE				187	187
MAIZE				355	355
MANDARIN		427.5			427.5
MINT				11	11
OKRA				229	229
OLIVE			127		127
ONION, DRY				275	275
ORANGE NAVEL		800			800
ORANGE, FRENCH		56			56
ORANGE, KING		18			18
ORANGE, LOCAL		54			54
ORANGE, RED		260			260
ORANGE, SHAMOUTI		237			237
ORANGE, SOUR		926			926
ORANGE, VALENCIA		152			152
PARSLEY				37	37
PEAS				4	4
POMEGRANATE			47		47
POTATO				770	770
PUMPKIN				4	4
RADISH				14	14
SILQ				1.5	1.5
SNAKE CUCUMBER				11	11
SPINACH				22	22
SQUASH				66	66
STRING BEANS				139.5	139.5
SWEET PEPPER				44	44
TOMATO				1752.2	1752.2
TURNIP				2	2
WHEAT				497	497
ZUCCHINI				920	920
Grand Total	394	4803.5	434	7502.9	13134.4

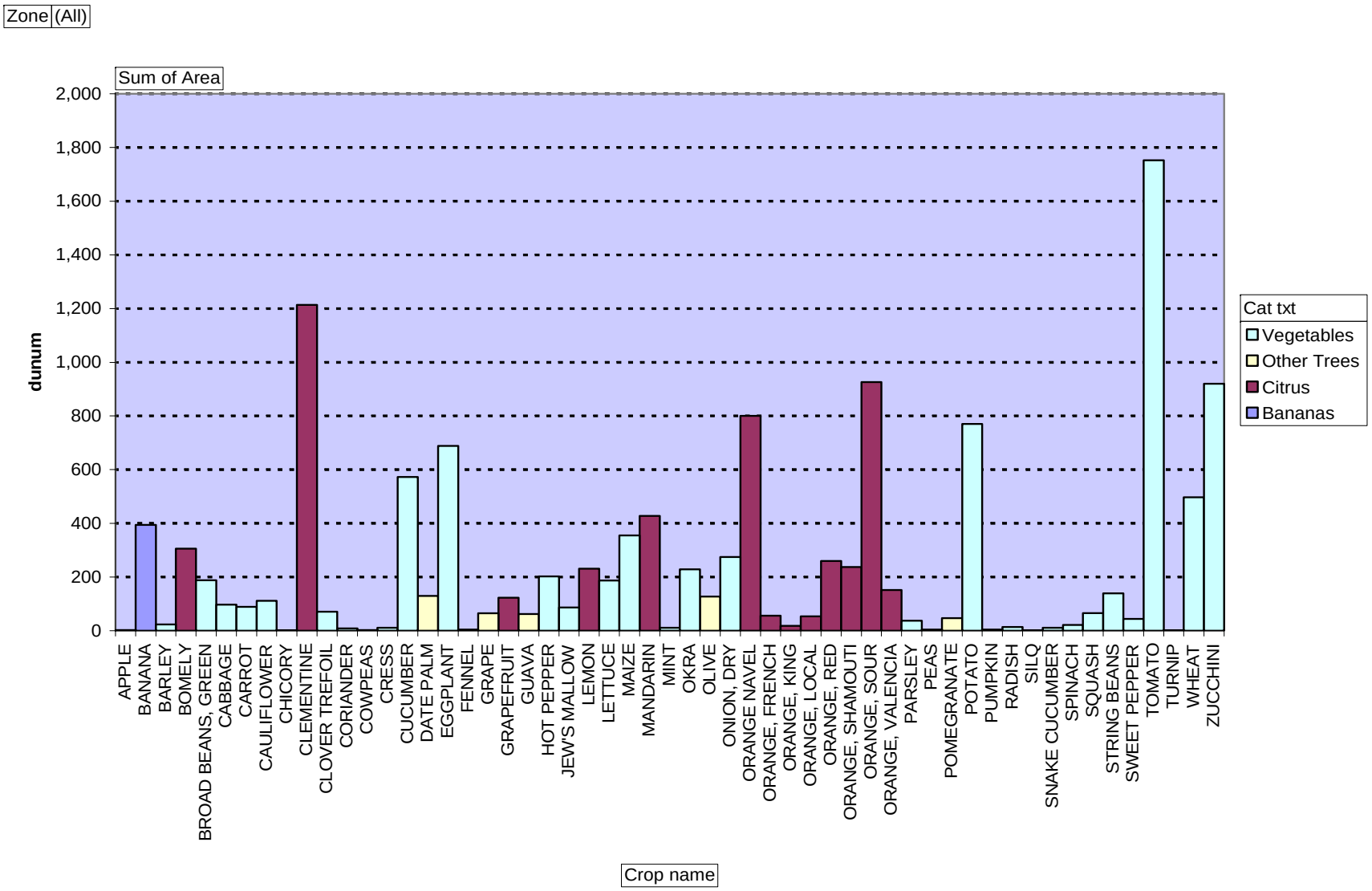


Figure 7 a. Cropping pattern in the Jordan Valley, 2002-2003

Table 7 – b. Cropping pattern among survey sample farms in the North Jordan Valley. Season 2002-2003.

Table 7-b. Cropping pattern among survey sample farms in the North Jordan Valley. Season 2002-2003

Zone	North				
Sum of Area	Cat txt				
Crop name	Bananas	Citrus	Other Trees	Vegetables	Grand Total
APPLE			3		3
BANANA	339				339
BARLEY				17	17
BOMELY		193			193
BROAD BEANS, GREEN				33	33
CABBAGE				36	36
CAULIFLOWER				26	26
CLEMENTINE		1030			1030
CLOVER TREFOIL				71	71
COWPEAS				3	3
DATE PALM			41		41
EGGPLANT				102	102
GRAPE			15		15
GRAPEFRUIT		111			111
GUAVA			47		47
HOT PEPPER				8	8
JEW'S MALLOW				76	76
LEMON		200			200
LETTUCE				8	8
MAIZE				12	12
MANDARIN		346.5			346.5
OKRA				117	117
OLIVE			74		74
ONION, DRY				7	7
ORANGE NAVEL		643			643
ORANGE, FRENCH		54			54
ORANGE, KING		18			18
ORANGE, LOCAL		54			54
ORANGE, RED		260			260
ORANGE, SHAMOUTI		192			192
ORANGE, SOUR		879			879
ORANGE, VALENCIA		152			152
PARSLEY				4	4
POMEGRANATE			47		47
POTATO				126.5	126.5
RADISH				10	10
SPINACH				22	22
STRING BEANS				84.5	84.5
SWEET PEPPER				25	25
TOMATO				310	310
WHEAT				232	232
ZUCCHINI				365	365
Grand Total	339	4132.5	227	1695	6393.5

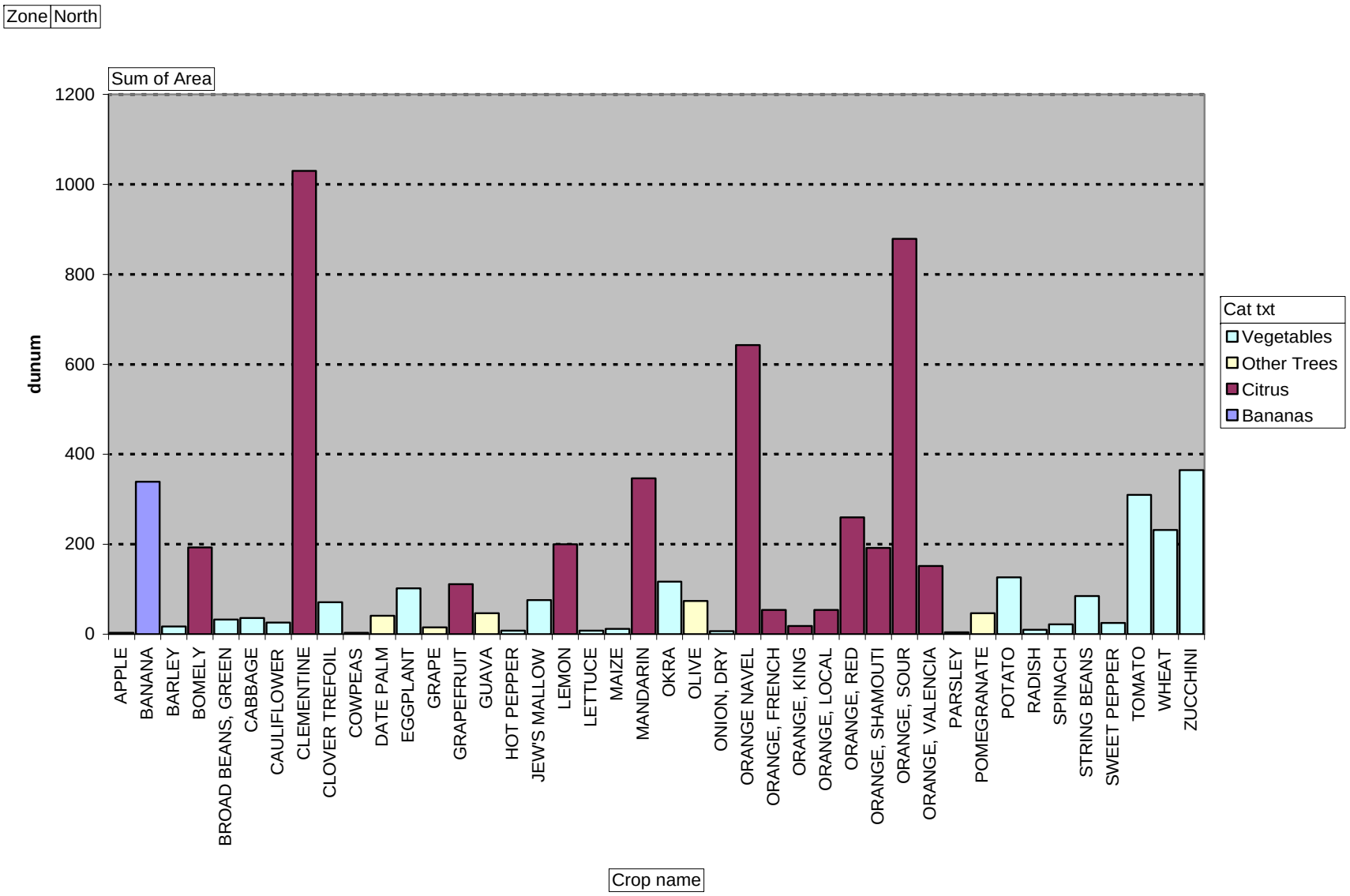


Figure 7 b. Cropping Pattern in the North Jordan Valley, 2002-2003

Table 7 – c. Cropping pattern among survey sample farms in the Center Jordan Valley, Season 2002-2003.

Table 7-c. Cropping pattern among survey sample farms in the Central Jordan Valley. Season 2002-2003

Zone	Central			
Sum of Area	Cat txt			
Crop name	Citrus	Other Trees	Vegetables	Grand Total
BARLEY			6	6
BOMELY	112.5			112.5
BROAD BEANS, GREEN			93	93
CABBAGE			42	42
CARROT			89.5	89.5
CAULIFLOWER			36	36
CLEMENTINE	183.5			183.5
CUCUMBER			488.7	488.7
DATE PALM		89		89
EGGPLANT			185	185
GRAPE		10		10
GRAPEFRUIT	12			12
GUAVA		15		15
HOT PEPPER			61	61
JEW'S MALLOW			11	11
LEMON	28			28
LETTUCE			43	43
MAIZE			169	169
MANDARIN	81			81
OKRA			68	68
OLIVE		6		6
ONION, DRY			255	255
ORANGE NAVEL	154			154
ORANGE, FRENCH	2			2
ORANGE, SHAMOUTI	45			45
ORANGE, SOUR	47			47
POTATO			554.5	554.5
SNAKE CUCUMBER			11	11
STRING BEANS			45	45
SWEET PEPPER			19	19
TOMATO			898.7	898.7
TURNIP			2	2
WHEAT			225	225
ZUCCHINI			402	402
Grand Total	665	120	3704.4	4489.4

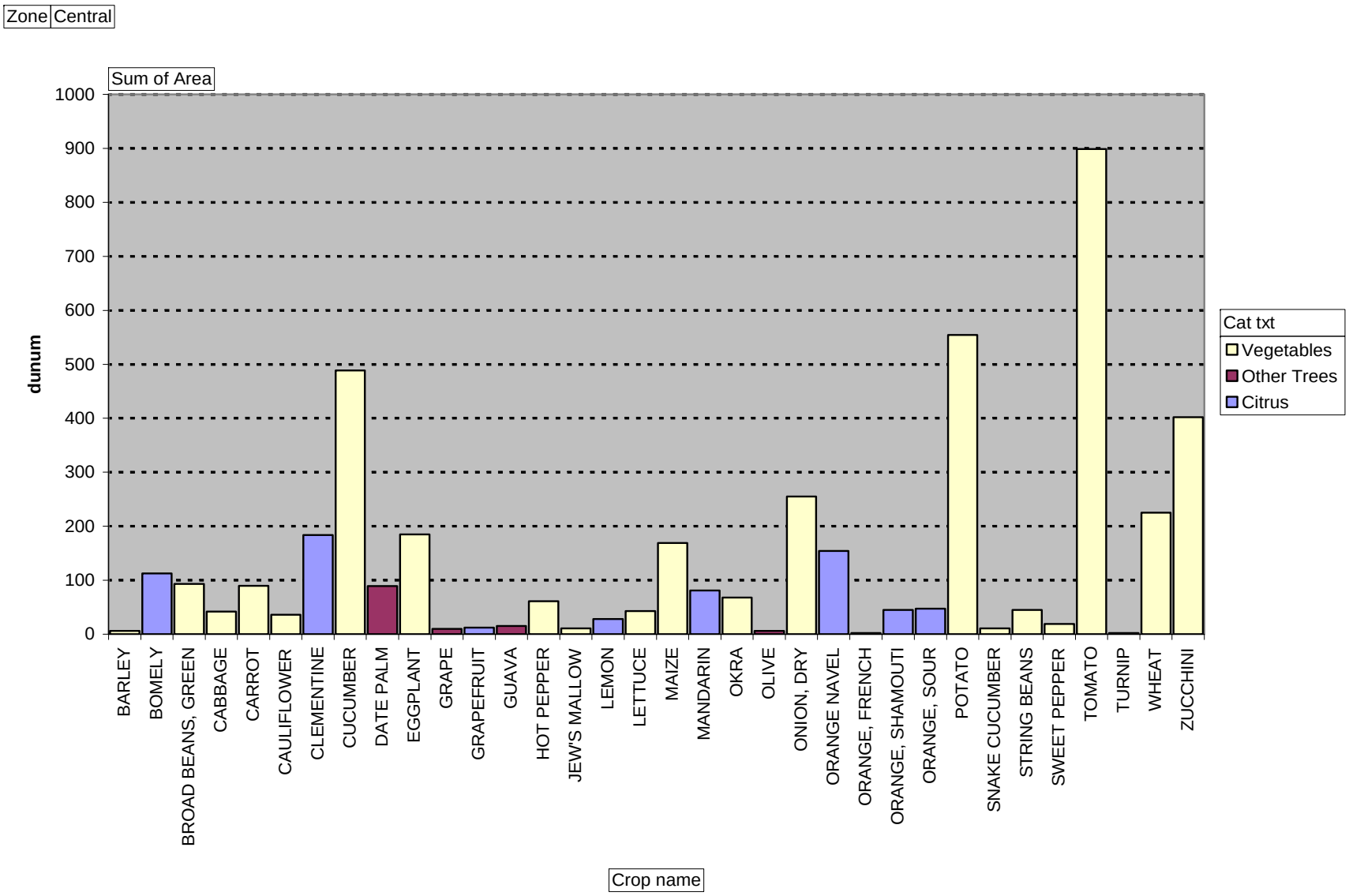


Figure 7 c. Cropping Pattern in the Central Jordan Valley. 2002-2003

Table 7 – d. Cropping pattern among survey sample farms in the South Jordan Valley, Season 2002-2003.

Table 7-d. Cropping pattern among survey sample farms in the South Jordan Valley Season 2002-2003

Zone	South				
Sum of Area	Cat txt				
Crop name	Bananas	Citrus	Other Trees	Vegetables	Grand Total
BANANA	55				55
BROAD BEANS, GREEN				62	62
CABBAGE				19	19
CAULIFLOWER				50	50
CHICORY				2	2
CORIANDER				9	9
CRESS				11.5	11.5
CUCUMBER				84	84
EGGPLANT				402	402
FENNEL				4	4
GRAPE			40		40
HOT PEPPER				134	134
LEMON		3			3
LETTUCE				136	136
MAIZE				174	174
MINT				11	11
OKRA				44	44
OLIVE			47		47
ONION, DRY				13	13
ORANGE NAVEL		3			3
PARSLEY				33	33
PEAS				4	4
POTATO				89	89
PUMPKIN				4	4
RADISH				4	4
SILQ				1.5	1.5
SQUASH				66	66
STRING BEANS				10	10
TOMATO				543.5	543.5
WHEAT				40	40
ZUCCHINI				153	153
Grand Total	55	6	87	2103.5	2251.5

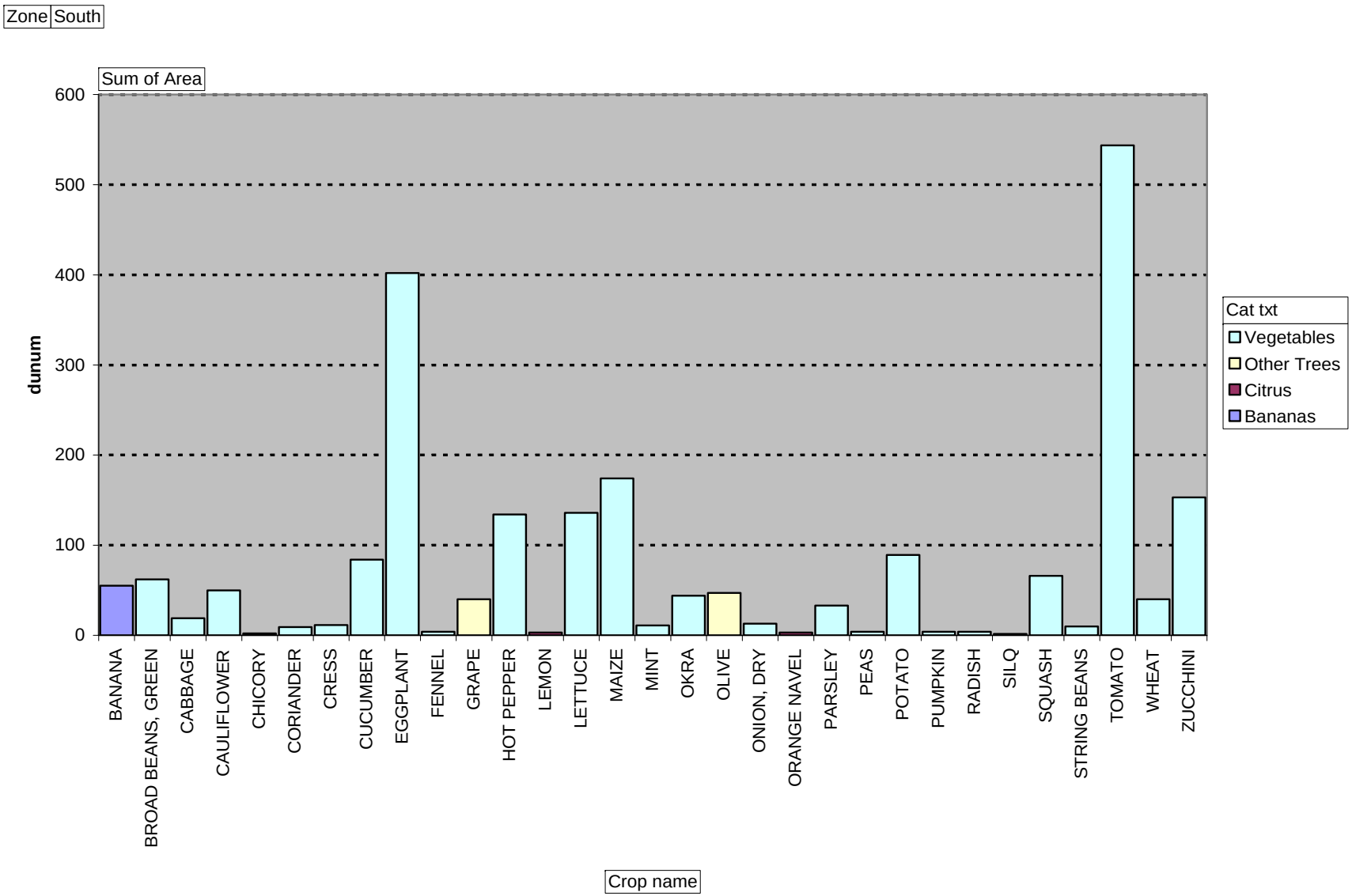


Figure 7-d. Cropping Pattern in the South Jordan Valley, 2002-2003

Table 8. Irrigation water needs by crop in the Jordan Valley, 2002-2003 cubic meters of irrigation water.

Table 8. Irrigation water needs by crop in the Jordan Valley, 2002-2003
cubic meters of irrigation water

Zone	(All)

Sum of Water	Cat txt				
Crop name	Bananas	Citrus	Other Trees	Vegetables	Grand Total
APPLE			2,254		2,254
BANANA	569,931				569,931
BARLEY				2,162	2,162
BOMELY		256,807			256,807
BROAD BEANS, GREEN				42,787	42,787
CABBAGE				17,356	17,356
CARROT				14,847	14,847
CAULIFLOWER				20,997	20,997
CHICORY				578	578
CLEMENTINE		956,135			956,135
CLOVER TREFOIL				12,737	12,737
CORIANDER				2,601	2,601
COWPEAS				557	557
CRESS				3,323	3,323
CUCUMBER				234,823	234,823
DATE PALM			119,265		119,265
EGGPLANT				192,240	192,240
FENNEL				1,156	1,156
GRAPE			67,568		67,568
GRAPEFRUIT		95,311			95,311
GUAVA			50,216		50,216
HOT PEPPER				60,855	60,855
JEW'S MALLOW				13,427	13,427
LEMON		185,329			185,329
LETTUCE				37,078	37,078
MAIZE				159,710	159,710
MANDARIN		340,805			340,805
MINT				3,179	3,179
OKRA				71,850	71,850
OLIVE			116,026		116,026
ONION, DRY				95,841	95,841
ORANGE NAVEL		639,575			639,575
ORANGE, FRENCH		42,553			42,553
ORANGE, KING		13,522			13,522
ORANGE, LOCAL		40,565			40,565
ORANGE, RED		195,312			195,312
ORANGE, SHAMOUTI		188,960			188,960
ORANGE, SOUR		707,023			707,023
ORANGE, VALENCIA		114,182			114,182
PARSLEY				10,279	10,279
PEAS				1,156	1,156
POMEGRANATE			35,306		35,306
POTATO				134,199	134,199
PUMPKIN				1,534	1,534
RADISH				2,570	2,570
SILQ				433	433
SNAKE CUCUMBER				2,572	2,572
SPINACH				4,084	4,084
SQUASH				17,622	17,622
STRING BEANS				27,646	27,646
SWEET PEPPER				9,128	9,128
TOMATO				512,304	512,304
TURNIP				332	332
WHEAT				55,891	55,891
ZUCCHINI				180,809	180,809
Grand Total	569,931	3,776,078	390,635	1,948,663	6,685,307

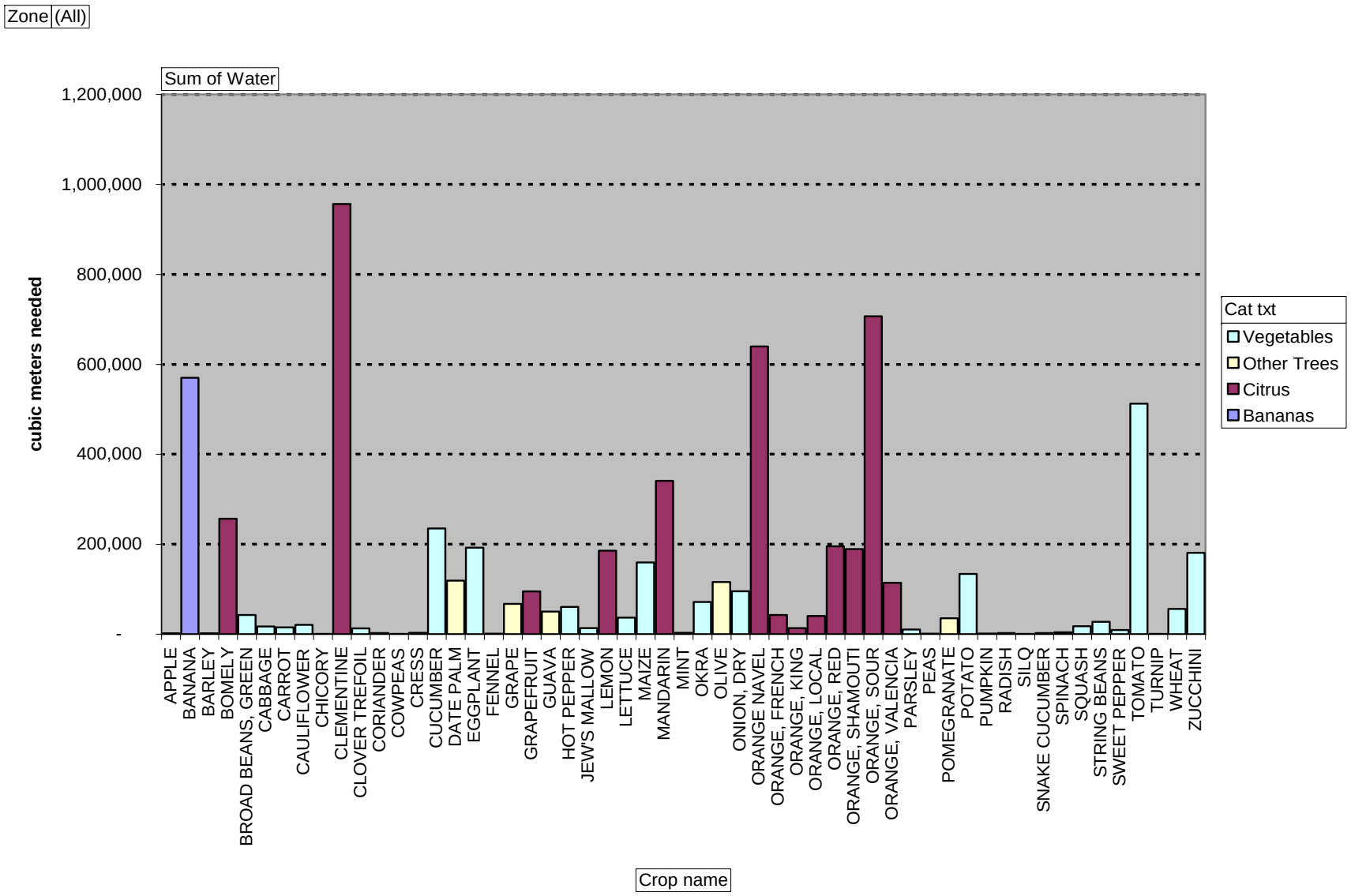


Figure 8. Water Needs by Crop in the Jordan Valley, 2002-2003

Table 9. Summary Tables of Planted Area, Water Needs and Value of Production by Crop Category and by Zone. Jordan Valley, 2002-2003.

Table 9. Summary Tables of Planted Area, Water Needs and Value of Production by Crop Category and by Zone.

Jordan Valley, 2002-3003

Sum of Area	Cat txt					
Zone	Bananas	Citrus	Other Trees	Vegetables	Grand Total	Percent
Central		665	120	3,704	4,489	34.2%
North	339	4,133	227	1,695	6,394	48.7%
South	55	6	87	2,104	2,252	17.1%
Grand Total	394	4,804	434	7,503	13,134	100.0%
Percent	3.0%	36.6%	3.3%	57.1%	100.0%	

Sum of Value	Cat txt					
Zone	Bananas	Citrus	Other Trees	Vegetables	Grand Total	Percent
Central		409,474	53,174	3,362,781	3,825,429	52.1%
North	385,075	1,884,312	56,174	361,451	2,687,011	36.6%
South	23,250	720	13,980	797,318	835,268	11.4%
Grand Total	408,325	2,294,506	123,328	4,521,550	7,347,708	100.0%
Percent	5.6%	31.2%	1.7%	61.5%	100.0%	

Sum of Water	Cat txt					
Zone	Bananas	Citrus	Other Trees	Vegetables	Grand Total	Percent
Central		661,010	119,280	967,218	1,747,508	26.1%
North	471,074	3,108,114	170,522	300,423	4,050,133	60.6%
South	98,857	6,954	100,833	681,022	887,666	13.3%
Grand Total	569,931	3,776,078	390,635	1,948,663	6,685,307	100.0%
Percent	8.5%	56.5%	5.8%	29.1%	100.0%	

Table 9. Continuation…

	Cat txt				
Data	Bananas	Citrus	Other Trees	Vegetables	Grand Total
Sum of Area	394	4,804	434	7,503	13,134
Sum of Value	408,325	2,294,506	123,328	4,521,550	7,347,708
Sum of Water	569,931	3,776,078	390,635	1,948,663	6,685,307

Comparative Returns to Water in the Jordan Valley, 2002-2003					
	Bananas	Citrus	Other Trees	Vegetables	Average
JD/dunum	1,036	478	284	603	559
M3/dunum	1,447	786	900	260	509
JD/1000 m3	716	608	316	2,320	1,099

Comparative Returns to Water in the Jordan Valley, 2002-2003					
	Bananas	Citrus	Other Trees	Vegetables	Total
Area	3.0%	36.6%	3.3%	57.1%	100.0%
Water	8.5%	56.5%	5.8%	29.1%	100.0%
Value	5.6%	31.2%	1.7%	61.5%	100.0%

	Zone			
Data	Central	North	South	Grand Total
Sum of Area	4,489	6,394	2,252	13,134
Sum of Water	1,747,508	4,050,133	887,666	6,685,307
Sum of Value	3,825,429	2,687,011	835,268	7,347,708

Comparative Returns to Water in the Jordan Valley, 2002-2003				
	Center	North	South	Average
JD/dunum	852	420	371	559
M3/dunum	389	633	394	509
JD/1000 m3	2,189	663	941	1,099

Comparative Returns to Water in the Jordan Valley, 2002-2003				
	Center	North	South	Average
Area	34.2%	48.7%	17.1%	100.0%
Water	26.1%	60.6%	13.3%	100.0%
Value	52.1%	36.6%	11.4%	100.0%

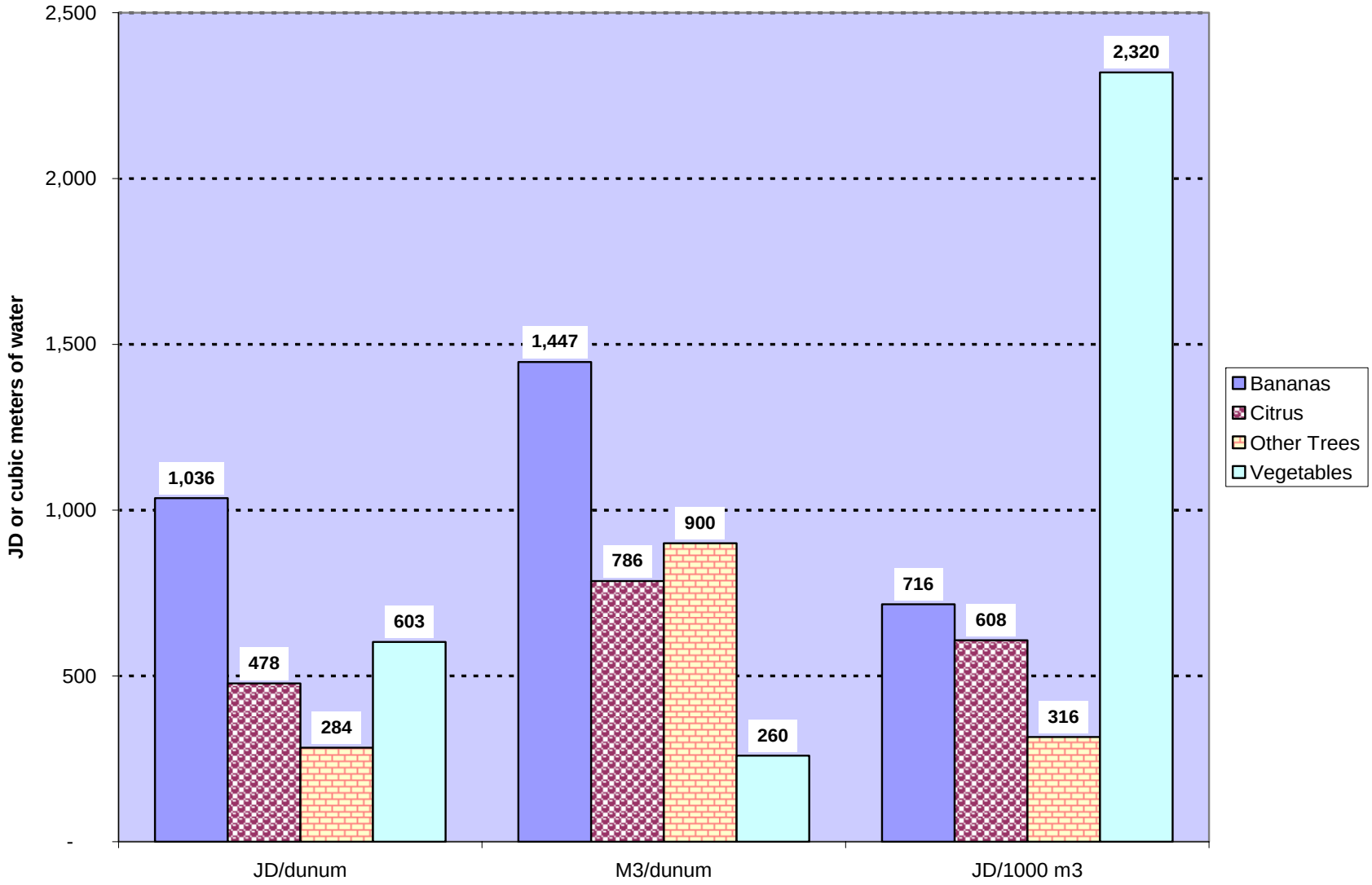


Figure 9-a. Comparative Returns to Water in the Jordan Valley. 2002-2003

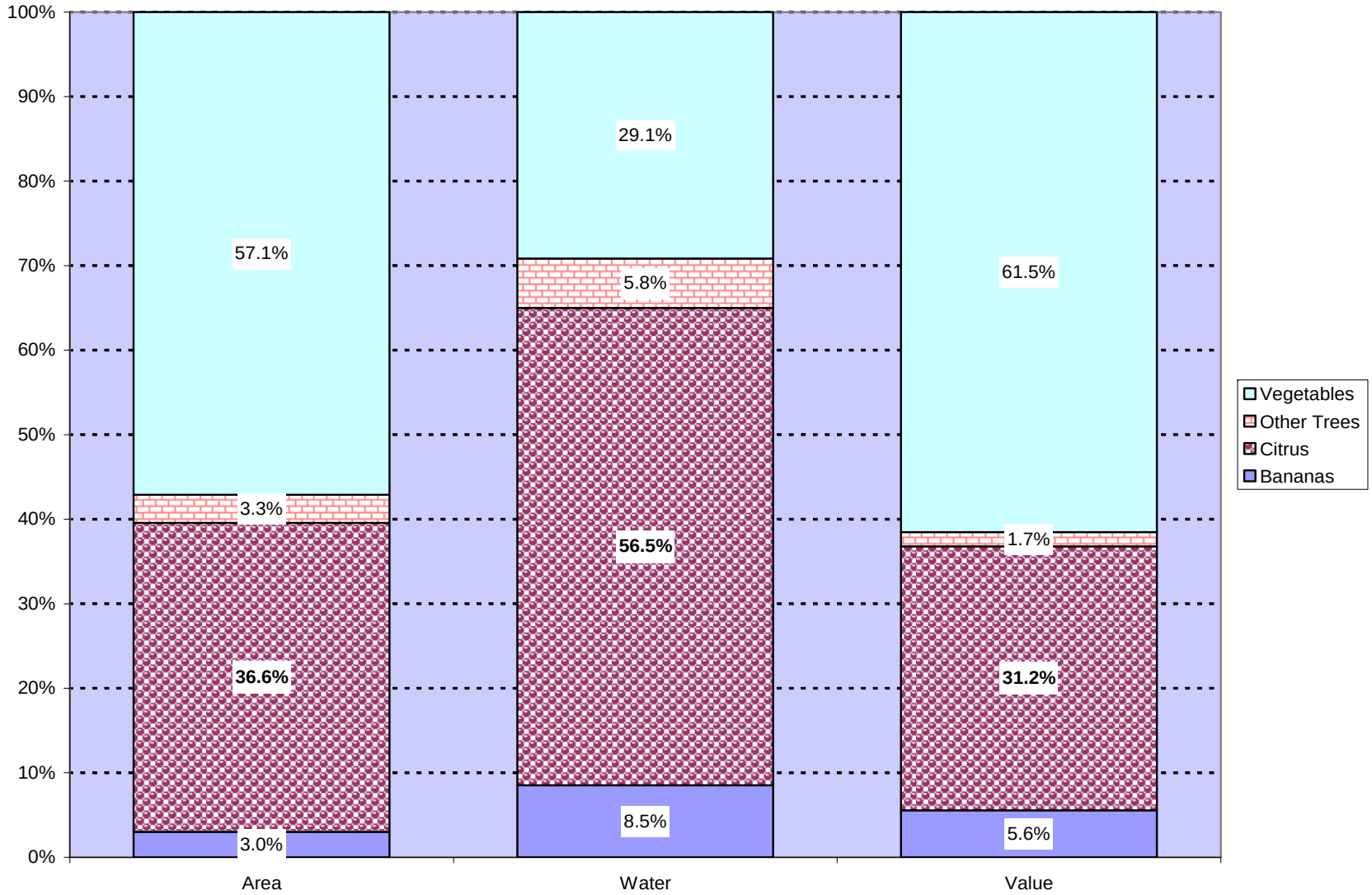


Figure 9-b. Percent Distribution of Area, Water, and Value by Crop Category. Jordan Valley, 2002-2003

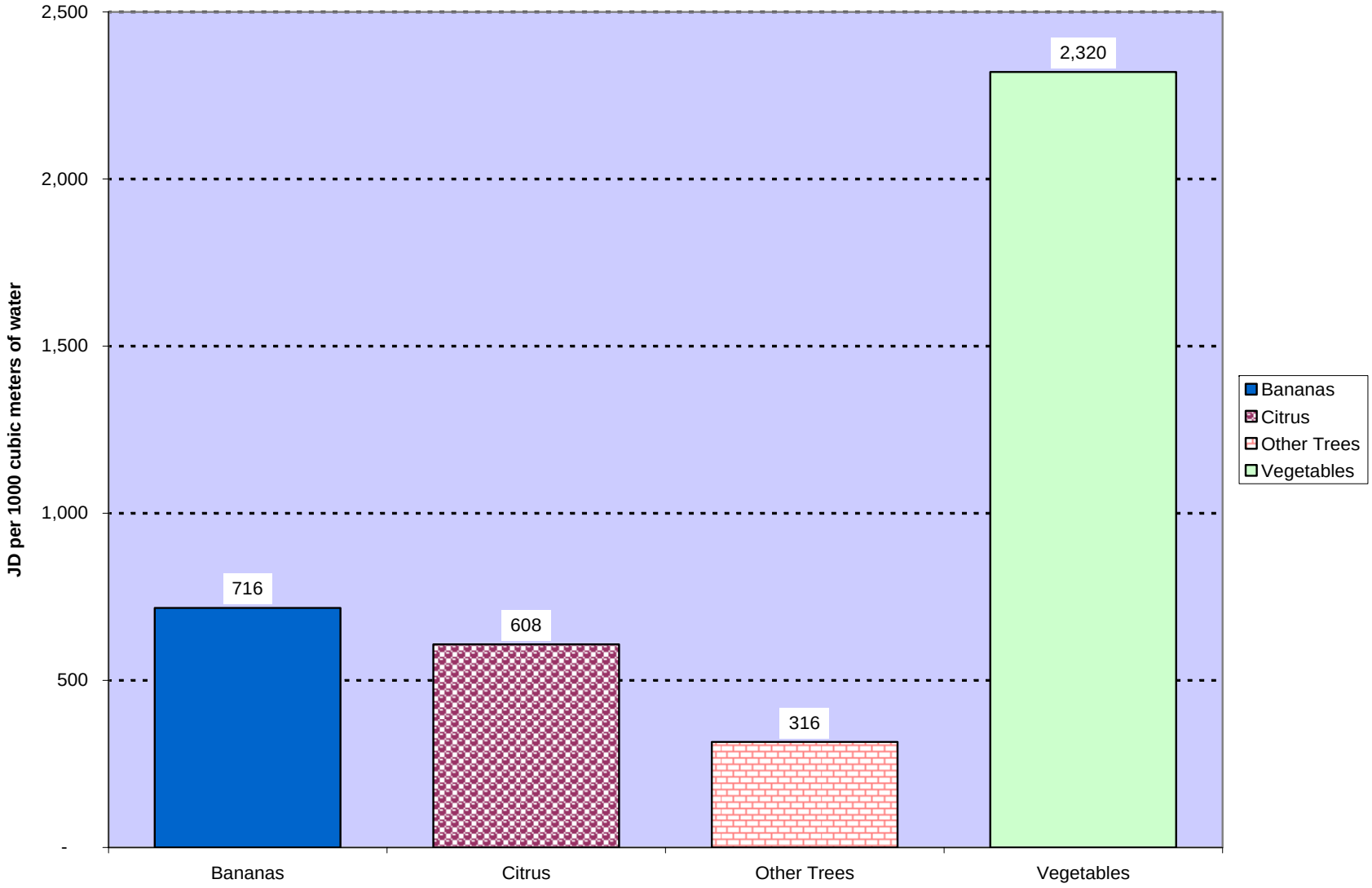


Figure 9-c. Value of Production per 1000 cubic meters of Water, by Crop Category. Jordan Valley, 2002-2003

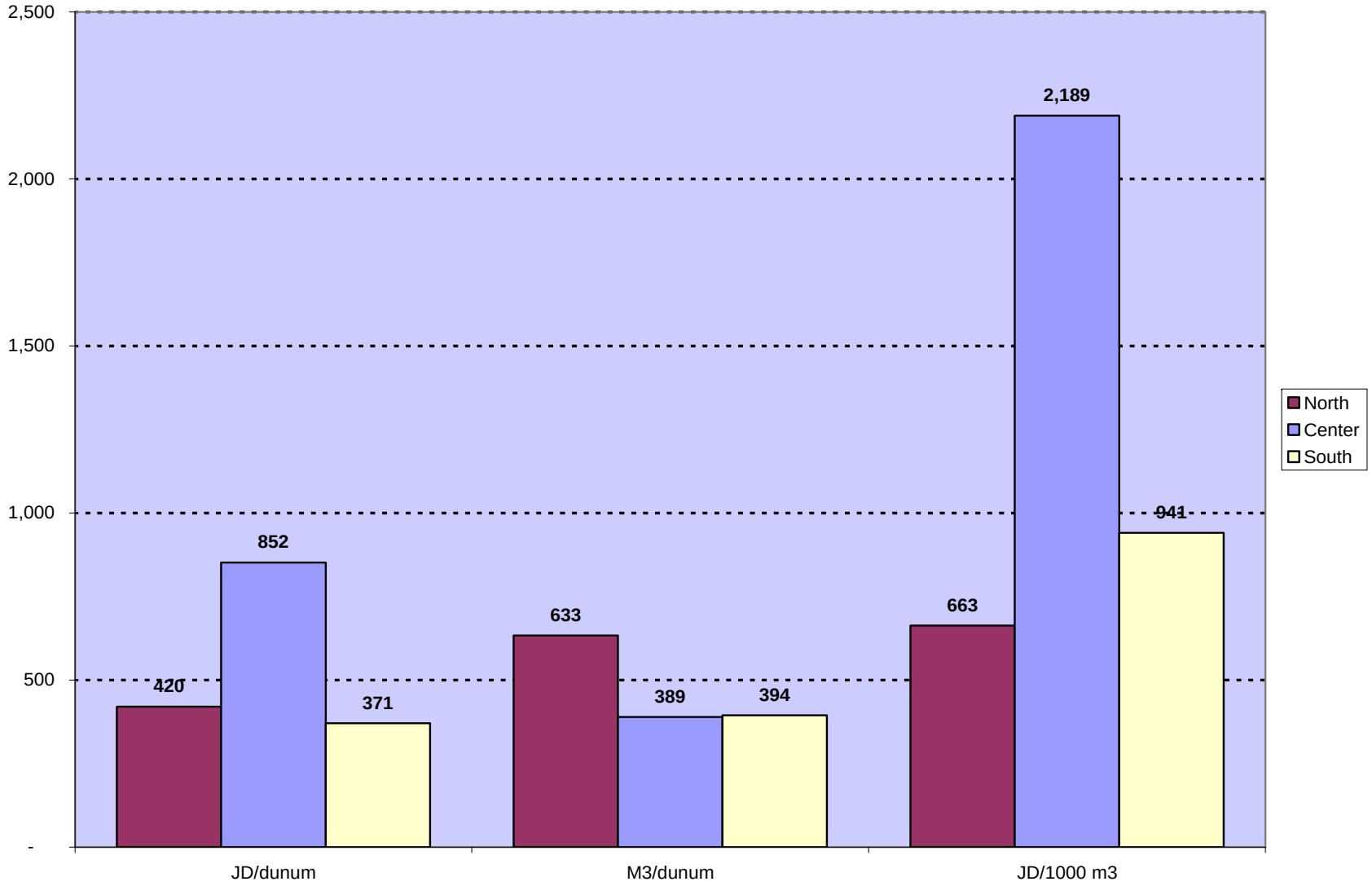


Figure 9-d. Comparative Water Needs and Production Value by Zone in Jordan Valley, 2002-2003

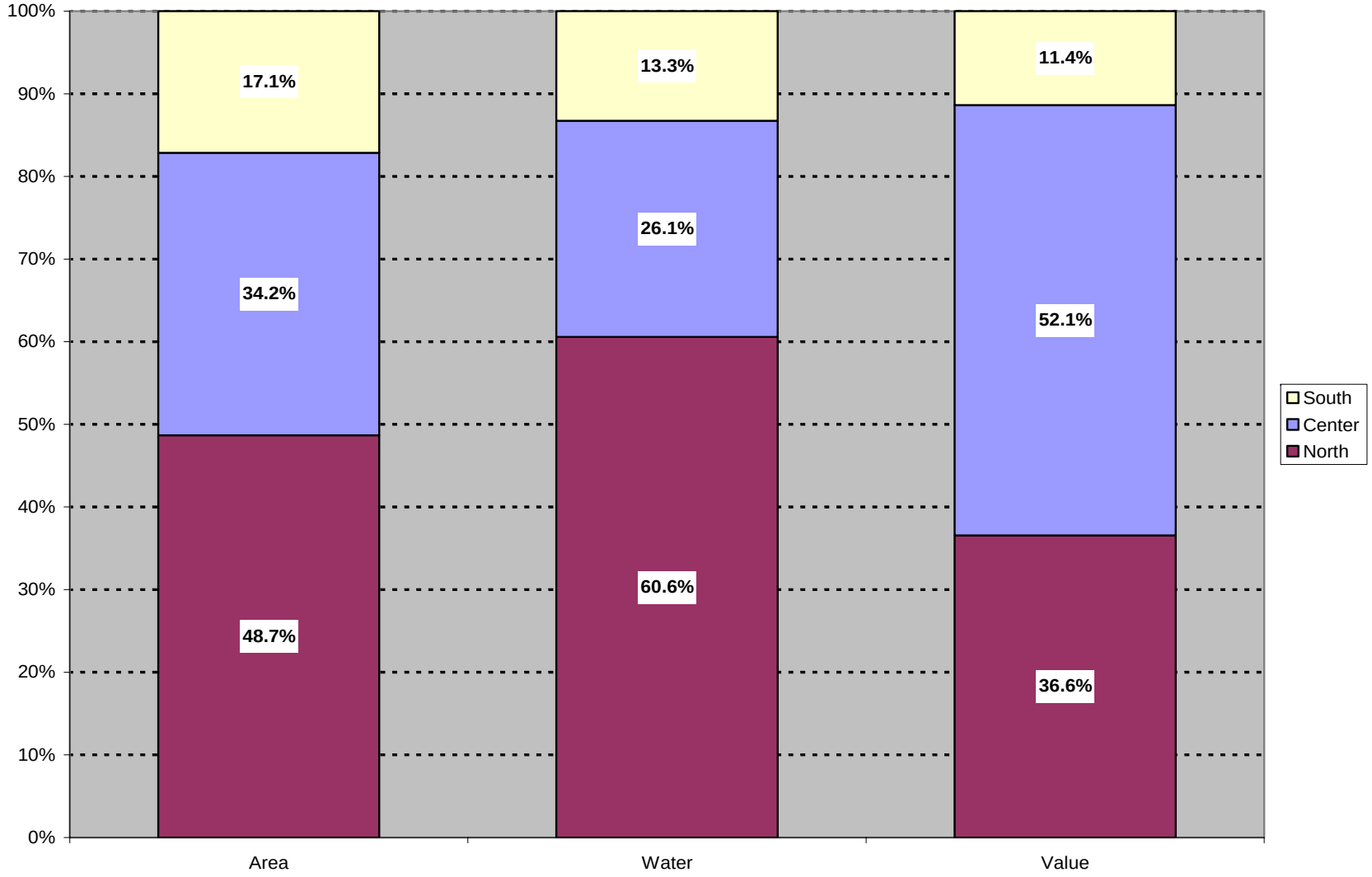


Figure 9-e. Percent distribution of Area, Water, and Value of Production by Zone in the Jordan Valley, 2002-2003

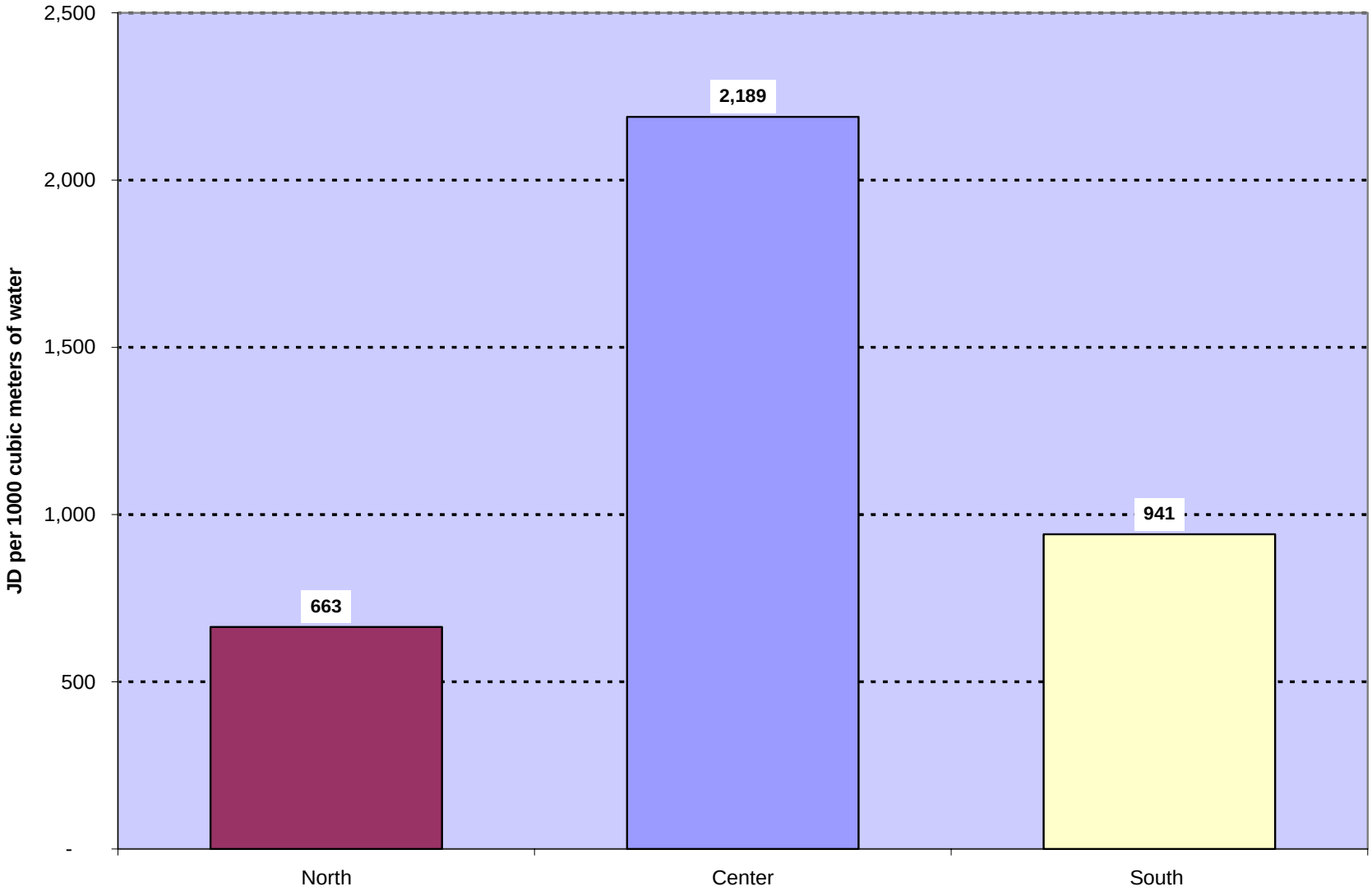


Figure 9-f. Value of Production per 1000 cubic meters or Water, by Zone in the Jordan Valley, 2002-2003

Table 10. Water Bills from the Jordan Valley Authority to the Survey Sample Farms in the Jordan Valley, Season 2000-2004.

Table 10. Water Bills from the Jordan Valley Authority to the Survey Sample Farms in the Jordan Valley, 2000-2004											
Zone	Area	Unit	2000	2001	2002	2003	2004	2000-01	2001-02	2002-03	2003-04
2	15	150055	20,032	10,763	1,516	19,314	11,484	13,409	6,062	8,589	15,211
2	15	150066	10,713	6,918	2,394	16,513	7,537	7,779	4,962	8,407	13,395
2	15	150069	10,423	5,199	1,945	11,794	4,728	8,244	3,403	6,156	9,330
2	15	150075	9,754	5,426	2,171	12,068	4,730	7,340	4,050	4,989	10,189
2	15	150076	12,041	4,750	2,286	9,973	6,384	7,258	3,861	4,395	9,240
2	15	150088	616	2,118	713	14,061	8,295	2,734	713	7,128	11,793
2	15	150092	26,121	19,657	1,992	24,905	21,037	21,224	11,325	10,582	25,683
2	15	150102	27,528	22,794	3,153	34,279	24,311	25,569	12,962	13,478	36,472
2	15	150116	21,046	58,472	2,077	24,826	17,237	57,109	11,835	9,662	24,467
2	16	160002	16,842	5,634	2,450	16,798	14,157	12,307	2,450	8,604	15,004
2	16	160004	19,108	7,073	2,141	23,414	12,451	15,722	2,141	13,072	18,005
2	16	160009	17,165	5,587	3,434	18,661	14,548	11,778	3,434	8,035	19,342
2	16	160021	10,849			11,661	7,550	6,709			11,140
2	16	160022	13,933	4,235		13,148	8,701	9,453	5,402		12,575
2	16	160024	11,178	4,698	3,629	14,402	9,461	8,102	3,629	6,546	14,401
2	16	160038	10,693	3,725	1,393	13,996	12,750	7,421	1,393	6,286	14,628
2	16	160047	32,949	15,970	3,577	31,103	26,101	29,476	3,577	15,896	30,643
2	16	160050	24,204	11,741		17,964	11,156	20,164	8,514		14,352
2	16	160051	16,039	9,927	1,976	17,220	12,450	16,177	1,976	8,538	15,105
2	16	160052	21,579	3,852	940	9,988	7,335	13,018	940	4,428	9,466
2	16	160058	20,341	8,318	3,790	23,647	15,470	15,738	3,790	10,997	21,923
2	16	160062	-	-		15,153	4,347	-	6,894		10,986
2	16	160066	18,907	5,140		19,381	10,903	10,135	9,191		17,961
2	16	160077	6,867	3,382	2,476	12,426	7,509	5,577	2,476	5,651	13,353
2	16	160097	9,489	5,911	2,528	11,018	7,866	7,181	4,634	5,786	9,494
2	16	160112	15,064	7,202	3,435	19,366	11,703	10,533	5,379	9,833	15,793
2	16	160118	9,505	4,587	4,461	20,425	9,961	5,775	6,405	11,514	16,820
2	16	160129	8,032	4,373	3,888	16,942	12,452	3,467	5,800	9,012	17,379
2	16	160214	20,264	13,699	3,659	27,427	14,108	17,044	8,691	10,641	24,672
2	17	170003	14,467	7,382	3,534	9,584	12,544	9,357	6,225	300	18,713
2	17	170015	15,996	9,527	4,024	25,218	12,378	11,740	6,867	11,101	22,623
2	17	170017	14,161	7,699		25,399	11,693	10,918	13,152		20,337
2	17	170018	18,550	7,614	3,434	23,639	11,804	9,423	6,285	11,546	20,240
2	17	170045	24,294	9,709	1,782	33,978	20,501	16,615	3,726	16,330	29,032
2	17	170049	13,193	6,137	3,834	17,293	8,441	9,143	4,908	8,589	14,652
2	39	390009	11,818	12,704	3,623	18,515	-	12,564	10,060	6,543	11,972
2	39	390012	9,311	8,917	3,715	23,209	-	8,519	8,759	7,981	15,228
3	19	190002	40,191	29,574	39,776	56,633	21,554	35,406	33,847	49,134	43,209
3	19	190011	22,384	10,207	14,709	19,957	12,325	16,979	10,659	16,282	20,455
3	19	190015	26,640	14,023	16,201	26,380	6,750	19,790	15,131	19,419	19,745
3	19	190016	24,372	15,068	19,957	27,705	7,498	20,834	18,501	23,827	18,561
3	19	190026	22,194	18,470	24,137	30,586	13,197	20,414	22,647	26,958	24,481
3	19	190029	48,659	42,400	51,840	53,039	23,944	46,008	47,034	51,786	44,839
3	19	190039	77,368	53,920	76,104	83,297	44,712	60,612	65,932	80,489	77,544
3	19	190041	18,112	9,008	14,256	22,031	10,779	14,127	13,155	15,454	20,110
3	19	190054	21,520	15,941	20,249	31,331	14,255	20,121	19,828	22,551	27,992
3	19	190082	21,351	18,382	21,056	21,188	11,146	20,974	20,606	19,533	18,986
3	19	190088	2,105	4,839	8,456	1,393	1,555	4,967	7,355	4,471	-
3	19	190089	-	-	2,138	-	745	-	-	2,138	-
3	19	190092	2,505	-	-	-	1,303	2,505	-	-	-
3	20	200001	19,483	10,509	16,297	27,509	14,035	16,267	13,512	19,181	27,095
3	20	200009	27,977	10,557	15,001	12,053	11,441	18,756	14,224	5,509	20,999
3	20	200034	18,267	13,793	24,026	20,012	21,677	19,683	21,023	19,626	27,758

Table 11. Area Planted, Value of Production, and Water Needs of Sample Farms in the Jordan Valley, 2002-2003.

able 11. Area Planted, Value of Production, and Water Needs of Sample Farm in the Jordan Valley, 2002-2003

Field_Unit_code	Area	Water	Value Pdn	JD/dunum	M3/dunum	JD/1000 m3	JVA Bill
10002	30	26,316	14,475	483	877	550	24,610
10003	42	50,702	38,145	908	1,207	752	54,444
10010	30	28,920	14,130	471	964	489	26,077
10030	30	22,536	56,450	1,882	751	2,505	19,405
10045	25	18,780	5,020	201	751	267	25,620
10089	53	39,814	16,484	311	751	414	25,230
20007	32	24,038	13,440	420	751	559	22,202
20021	29	21,785	8,091	279	751	371	14,880
20028	44	33,053	13,180	300	751	399	#N/A
30003	15	11,268	2,460	164	751	218	9,586
30018	12	9,014	284	24	751	31	12,699
30038	22	16,526	6,090	277	751	369	16,218
30053	30	12,577	7,950	265	419	632	-
30067	32	24,038	32,100	1,003	751	1,335	16,264
30096	27	25,390	10,315	382	940	406	18,007
30103	31	23,287	15,350	495	751	659	15,670
40037	27	20,282	16,980	629	751	837	18,002
40044	30	22,536	15,310	510	751	679	20,340
40050	53	39,814	47,640	899	751	1,197	16,956
40073	30	6,094	1,500	50	203	246	9,666
40085	20	12,762	3,160	158	638	248	15,905
40105	29	21,785	3,297	114	751	151	15,578
50003	29	18,354	3,625	125	633	198	16,191
50006	30	22,536	19,175	639	751	851	20,461
50011	30	5,382	2,250	75	179	418	14,958
50034	30	22,536	12,750	425	751	566	22,968
50040	28	21,034	5,970	213	751	284	18,115
50043	57	42,818	49,950	876	751	1,167	33,834
50050	31	23,287	16,230	524	751	697	15,599
50055	30	22,536	9,332	311	751	414	23,256
50106	40	55,584	16,000	400	1,390	288	49,727
50113	30	41,688	48,000	1,600	1,390	1,151	57,461
50156	32	5,789	6,520	204	181	1,126	13,943
60008	30	22,536	9,095	303	751	404	13,506
60013	16	12,019	4,385	274	751	365	12,185
60019	47	11,621	5,100	109	247	439	13,742
60021	26	19,531	7,275	280	751	372	19,553
60030	25	18,780	21,100	844	751	1,124	14,749
70025	26	19,531	12,000	462	751	614	14,395
70032	30	4,908	1,875	63	164	382	12,767
70042	45	33,804	9,530	212	751	282	30,048
70044	40	30,048	19,758	494	751	658	21,579
70054	40	30,048	14,232	356	751	474	22,526
70078	32	24,038	13,510	422	751	562	19,315
70080	35	5,355	4,250	121	153	794	21,895
70081	39	29,297	36,650	940	751	1,251	27,548
70091	29	21,785	15,450	533	751	709	21,247
70123	30	22,536	18,500	617	751	821	18,515
70134	30	22,536	20,310	677	751	901	16,722
70150	35	26,292	14,605	417	751	555	24,365
80004	16	2,644	2,840	178	165	1,074	8,852
80007	42	5,165	1,711	41	123	331	11,339
80015	10	7,512	1,660	166	751	221	15,559
80024	19	3,468	6,299	332	183	1,816	14,492

Table 11. Continuation

Field_Unit_code	Area	Water	Value Pdn	JD/dunum	M3/dunum	JD/1000 m3	JVA Bill
80038	29	21,785	11,880	410	751	545	18,371
80039	29	21,785	12,110	418	751	556	17,593
80047	25	18,780	8,973	359	751	478	14,613
80053	33	24,790	7,866	238	751	317	16,677
80084	30	22,536	23,725	791	751	1,053	16,066
80087	49	36,809	20,300	414	751	551	8,424
90015	34	18,018	5,076	149	530	282	19,279
100007	39	29,297	29,520	757	751	1,008	15,477
100008	28	21,034	20,880	746	751	993	16,206
100010	32	24,038	9,952	311	751	414	18,814
100013	39	6,946	7,888	202	178	1,135	9,784
100018	40	24,298	11,895	297	607	490	43,293
100020	20	3,534	2,100	105	177	594	9,471
100033	35	26,292	16,072	459	751	611	22,560
100036	26	19,531	9,135	351	751	468	8,943
100037	26	19,531	9,135	351	751	468	9,260
100041	26	19,531	11,425	439	751	585	19,254
100067	53	39,814	21,230	401	751	533	31,163
100069	148	111,178	52,830	357	751	475	62,935
100072	23	2,007	1,150	50	87	573	18,428
100073	30	22,536	10,965	366	751	487	13,837
100078	30	22,536	8,673	289	751	385	20,021
100082	29	21,785	12,050	416	751	553	17,964
100093	36	20,404	7,470	208	567	366	20,005
100098	38	28,546	20,930	551	751	733	26,489
100099	31	23,287	18,045	582	751	775	21,879
100109	37	27,794	4,239	115	751	153	18,622
100120	27	20,282	13,520	501	751	667	21,709
100129	21	15,775	5,156	246	751	327	16,890
100131	51	38,311	25,885	508	751	676	45,557
100169	28	21,034	16,440	587	751	782	18,474
100185	18	13,522	11,781	654	751	871	6,804
100203	21	15,775	3,420	163	751	217	18,586
100218	59	44,321	25,640	435	751	579	29,194
100221	37	27,794	13,665	369	751	492	22,219
100229	56	42,067	49,020	875	751	1,165	8,199
100254	50	37,560	7,500	150	751	200	13,897
100256	39	29,297	6,435	165	751	220	8,716
110011	28	21,034	4,140	148	751	197	6,672
110014	24	18,029	5,028	209	751	279	6,805
110022	33	24,790	11,654	353	751	470	6,048
110024	35	26,292	19,350	553	751	736	8,813
110028	29	21,785	8,583	296	751	394	5,851
110034	26	12,955	4,302	165	498	332	10,308
110038	29	21,785	6,318	218	751	290	7,335
110061	27	20,282	5,787	214	751	285	4,044
110062	28	21,034	3,601	129	751	171	6,284
110064	33	15,766	2,608	79	478	165	6,738
110083	12	9,014	1,620	135	751	180	4,003
110084	9	1,682	1,083	120	187	644	3,346
110138	18	13,522	6,020	334	751	445	7,996
110147	12	9,014	1,290	108	751	143	6,509
110163	22	15,149	2,010	91	689	133	7,595
110164	31	5,923	4,325	140	191	730	6,130

Table 11. Continuation

Field_Unit_code	Area	Water	Value Pdn	JD/dunum	M3/dunum	JD/1000 m3	JVA Bill
110180	37	27,794	2,520	68	751	91	8,859
110192	22	16,526	2,018	92	751	122	5,025
110209	39	29,297	10,778	276	751	368	10,825
110246	31	23,287	3,558	115	751	153	-
120063	29	21,785	9,175	316	751	421	10,195
120070	30	22,536	108,000	3,600	751	4,792	6,811
120093	30	5,835	8,548	285	195	1,465	7,124
120108	36	27,043	36,000	1,000	751	1,331	5,816
120158	40	7,180	13,000	325	179	1,811	10,317
120159	10	2,018	2,000	200	202	991	7,758
120168	22	11,964	4,848	220	544	405	8,148
120169	30	22,536	30,550	1,018	751	1,356	5,703
120172	35	3,055	1,540	44	87	504	-
120204	35	26,292	20,860	596	751	793	-
130009	55	13,270	17,235	313	241	1,299	6,545
130024	30	7,601	3,750	125	253	493	6,480
130032	33	24,790	7,476	227	751	302	5,507
130038	30	22,536	8,880	296	751	394	6,408
130061	25	2,182	837	33	87	384	3,376
130073	17	12,770	3,481	205	751	273	11,829
130083	30	4,675	7,850	262	156	1,679	6,443
140010	61	37,781	8,866	145	619	235	12,253
140028	37	27,794	14,625	395	751	526	14,336
140038	47	35,306	14,925	318	751	423	7,582
140047	10	2,505	2,690	269	250	1,074	5,047
140110	30	22,536	20,000	667	751	887	8,878
140111	31	23,287	28,813	929	751	1,237	8,619
140113	14	8,467	5,830	416	605	689	5,378
140117	29	21,785	5,760	199	751	264	8,619
150001	41	27,042	10,650	260	660	394	18,208
150022	31	23,287	18,000	581	751	773	10,410
150045	28	21,034	12,138	433	751	577	10,257
150050	28	5,137	3,475	124	183	676	3,930
150055	34	25,541	9,393	276	751	368	8,589
150066	16	2,873	3,670	229	180	1,278	8,407
150069	25	4,369	32,400	1,296	175	7,416	6,156
150088	28	4,391	-	-	157	-	7,128
150116	40	30,048	28,480	712	751	948	9,662
160002	25	18,780	11,350	454	751	604	8,604
160004	39	29,297	22,920	588	751	782	13,072
160009	20	12,724	8,250	413	636	648	8,035
160022	49	8,698	21,270	434	178	2,445	-
160024	30	5,406	7,250	242	180	1,341	6,546
160038	15	2,642	1,800	120	176	681	6,286
160047	37	46,946	14,125	382	1,269	301	15,896
160050	24	26,966	19,800	825	1,124	734	-
160051	28	27,418	15,615	558	979	570	8,538
160058	32	24,038	16,100	503	751	670	10,997
160066	30	5,603	8,725	291	187	1,557	-
160077	49	8,698	32,070	654	178	3,687	5,651
160097	9	1,537	3,994	444	171	2,599	5,786
160118	37	6,481	15,775	426	175	2,434	11,514
160129	27	5,958	10,750	398	221	1,804	9,012
160214	13	16,150	3,400	262	1,242	211	10,641

Table 11. Continuation

Field_Unit_code	Area	Water	Value Pdn	JD/dunum	M3/dunum	JD/1000 m3	JVA Bill
170015	63	12,390	19,100	303	197	1,542	11,101
170017	50	10,038	12,993	260	201	1,294	-
170018	34	6,656	11,895	350	196	1,787	11,546
170045	28.5	21,409	13,120	460	751	613	16,330
170049	30	5,958	8,620	287	199	1,447	8,589
190002	160	36,892	305,700	1,911	231	8,286	49,134
190011	70	13,418	30,450	435	192	2,269	16,282
190015	38	37,772	39,900	1,050	994	1,056	19,419
190016	10	9,940	3,750	375	994	377	23,827
190026	46	21,467	32,350	703	467	1,507	26,958
190041	36	13,862	124,200	3,450	385	8,959	15,454
190054	46	18,767	136,800	2,974	408	7,289	22,551
190082	32	31,808	19,710	616	994	620	19,533
190088	32	6,772	18,260	571	212	2,696	4,471
190092	18	8,479	1,080	60	471	127	-
200001	35	14,491	92,500	2,643	414	6,383	19,181
200009	50	20,267	142,750	2,855	405	7,044	5,509
200054	33	9,683	45,400	1,376	293	4,688	16,394
200069	35	7,453	11,250	321	213	1,510	22,679
210004	40	4,523	1,200	30	113	265	17,658
210041	21	7,810	58,600	2,790	372	7,503	18,630
210063	10	3,851	30,000	3,000	385	7,791	16,919
210169	45	17,494	34,400	764	389	1,966	1,522
210186	5.5	2,341	16,500	3,000	426	7,049	8,488
210192	46	9,111	5,385	117	198	591	8,006
210200	70	14,173	4,375	63	202	309	-
210213	34.5	7,354	10,895	316	213	1,482	8,392
210224	35	6,640	7,543	216	190	1,136	9,947
210226	25.5	5,812	10,850	425	228	1,867	10,498
210232	14	3,040	1,440	103	217	474	12,838
220036	22.5	7,921	30,743	1,366	352	3,881	21,525
220060	20	7,444	18,650	933	372	2,505	22,291
220072	17	5,682	34,760	2,045	334	6,118	16,362
220126	30	12,160	44,850	1,495	405	3,688	14,899
220128	30	4,137	6,750	225	138	1,631	18,007
220137	24	23,856	15,750	656	994	660	32,053
220150	8.5	3,435	23,150	2,724	404	6,739	26,770
220158	20	8,512	25,200	1,260	426	2,961	24,793
220179	8.5	3,455	29,540	3,475	407	8,549	#N/A
220192	17	6,546	71,400	4,200	385	10,907	23,844
220200	25	24,850	6,998	280	994	282	32,054
220212	20	4,020	10,080	504	201	2,507	15,303
220243	20	19,880	7,445	372	994	374	#N/A
220280	15	5,483	6,495	433	366	1,185	24,634
220312	30	29,820	3,100	103	994	104	28,080
220313	115	114,310	50,750	441	994	444	#N/A
220320	55	6,219	2,310	42	113	371	-
220363	54	53,676	41,694	772	994	777	38,585
220364	75	21,817	114,750	1,530	291	5,260	32,901
230008	19	6,504	43,050	2,266	342	6,619	26,895
230038	26	6,907	6,310	243	266	914	19,818
230064	30	6,525	30,000	1,000	217	4,598	20,452
230081	30	13,394	1,920	64	446	143	2,203
230129	21	4,761	5,800	276	227	1,218	17,286

Table 11. Continuation

Field_Unit_code	Area	Water	Value Pdn	JD/dunum	M3/dunum	JD/1000 m3	JVA Bill
230143	24	6,306	14,004	584	263	2,221	23,976
230227	20	3,496	7,050	353	175	2,017	19,335
230228	9	3,830	16,875	1,875	426	4,406	22,330
230232	30	4,977	13,200	440	166	2,652	12,347
230233	66.5	27,492	138,020	2,075	413	5,020	29,692
230247	15	3,267	15,300	1,020	218	4,683	19,881
230293	13.5	5,685	28,320	2,098	421	4,982	27,730
230297	18	6,412	23,400	1,300	356	3,649	21,290
230320	26	8,172	6,400	246	314	783	25,368
230324	8.5	1,937	1,154	136	228	596	15,441
230345	10	4,465	900	90	446	202	-
230371	30	6,525	12,600	420	217	1,931	14,255
230398	10	1,659	5,000	500	166	3,014	15,811
230399	80	23,801	44,500	556	298	1,870	17,011
230423	23	8,235	2,472	107	358	300	23,732
230431	25	2,827	750	30	113	265	17,654
230436	33	3,732	982	30	113	263	-
230452	32	7,416	35,120	1,098	232	4,736	27,068
230479	23	6,418	28,250	1,228	279	4,401	26,583
230483	30	7,089	9,250	308	236	1,305	22,574
230486	30	4,827	4,600	153	161	953	13,730
230487	30	5,814	21,300	710	194	3,663	17,667
230544	13	2,742	1,560	120	211	569	19,051
230546	46	11,906	15,975	347	259	1,342	19,774
230648	35	3,958	1,495	43	113	378	-
230657	35	6,587	700	20	188	106	16,861
240031	32	8,416	13,588	425	263	1,615	20,024
240063	28	11,025	59,520	2,126	394	5,399	17,430
240067	30	29,820	1,500	50	994	50	31,794
240079	40	8,114	10,400	260	203	1,282	18,242
240103	49	9,964	23,810	486	203	2,390	19,310
250016	30	5,646	26,400	880	188	4,676	24,908
250022	20	7,701	21,600	1,080	385	2,805	26,442
250024	30	5,286	27,840	928	176	5,267	21,867
250040	20	7,701	50,000	2,500	385	6,492	19,732
250050	5.4	2,189	10,501	1,945	405	4,798	22,003
250064	30	4,977	52,500	1,750	166	10,549	14,020
250076	20.5	8,725	40,180	1,960	426	4,605	16,928
250086	19	7,641	36,400	1,916	402	4,764	27,356
250101	18	7,438	40,200	2,233	413	5,405	16,780
250112	31	30,814	10,150	327	994	329	10,838
250158	42	10,014	9,020	215	238	901	17,226
250169	28	4,645	14,700	525	166	3,165	9,818
250191	40	13,660	4,608	115	342	337	14,618
250200	31	4,275	6,510	210	138	1,523	15,125
250239	47	20,003	50,760	1,080	426	2,538	24,739
250270	37	7,595	9,210	249	205	1,213	25,466
250281	30	12,160	39,000	1,300	405	3,207	18,181
250288	30	5,636	9,225	308	188	1,637	14,692
250310	50	9,411	17,500	350	188	1,860	16,266
250360	25	6,423	4,700	188	257	732	5,894
250365	27	5,517	6,150	228	204	1,115	-
250368	30	4,977	13,500	450	166	2,713	#N/A
250410	35	34,790	30,650	876	994	881	-

Table 11. Continuation

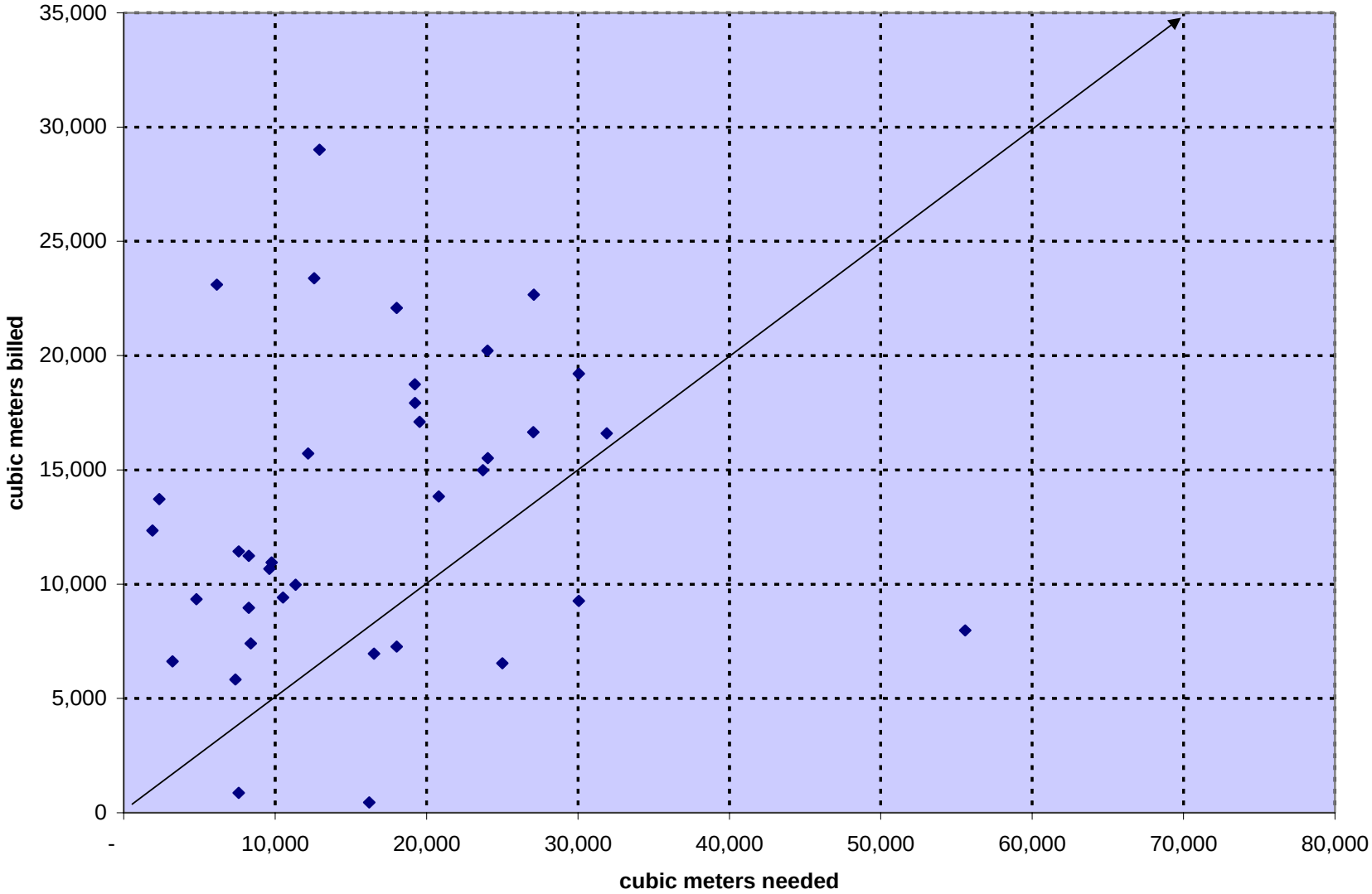
Field_Unit_code	Area	Water	Value Pdn	JD/dunum	M3/dunum	JD/1000 m3	JVA Bill
250428	30	4,977	30,000	1,000	166	6,028	12,958
260025	52	15,529	13,395	258	299	863	19,942
260030	35	10,859	11,090	317	310	1,021	17,444
260046	61	17,593	17,380	285	288	988	22,819
260050	24	7,207	7,485	312	300	1,039	31,260
260070	80	25,553	32,000	400	319	1,252	31,860
260080	38	11,363	8,633	227	299	760	19,378
260125	40	13,741	8,400	210	344	611	-
260126	40	15,344	12,000	300	384	782	-
260127	40	46,360	2,000	50	1,159	43	-
260168	45	14,211	12,088	269	316	851	32,824
260200	30	9,441	11,238	375	315	1,190	25,889
260205	35	11,441	13,500	386	327	1,180	21,675
260210	45	15,458	14,063	313	344	910	32,326
260217	40	12,629	12,150	304	316	962	22,890
260225	40	11,796	10,800	270	295	916	24,168
260239	20	7,425	2,800	140	371	377	17,318
260246	40	13,069	9,050	226	327	692	22,097
260248	36	11,381	6,100	169	316	536	20,932
260259	21.5	7,564	20,800	967	352	2,750	25,606
260292	30	8,650	8,310	277	288	961	20,330
260294	60	23,482	9,000	150	391	383	20,685
260304	32	11,787	9,450	295	368	802	20,260
270014	16	6,222	7,240	453	389	1,164	22,175
270035	35	14,546	21,000	600	416	1,444	20,622
270080	28	7,507	21,240	759	268	2,829	19,792
270087	25	7,985	7,500	300	319	939	25,776
270108	34	18,360	10,900	321	540	594	16,712
270110	35	11,191	8,600	246	320	768	18,857
270124	31	8,761	6,055	195	283	691	22,092
270125	40	10,199	2,200	55	255	216	35,652
270130	28	7,825	2,950	105	279	377	10,249
270140	36	12,063	10,170	283	335	843	19,294
270185	40	12,720	16,600	415	318	1,305	18,526
270195	40	8,873	4,000	100	222	451	20,145
270217	7	2,401	860	123	343	358	22,000
270219	43	14,288	14,050	327	332	983	22,746
270222	25	10,640	29,350	1,174	426	2,758	31,210
270254	15	4,335	469	31	289	108	24,698
270268	10	2,890	250	25	289	87	21,151
270271	20	5,780	3,120	156	289	540	-
270296	5	1,445	7,613	1,523	289	5,268	2,342
270319	20	6,470	10,000	500	324	1,546	26,224
270321	24	7,350	8,640	360	306	1,175	24,946
270378	38	14,273	8,300	218	376	582	19,818
270384	60	43,894	15,420	257	732	351	35,408
270427	20	9,071	1,600	80	454	176	13,556
280015	55	16,987	21,750	395	309	1,280	18,313
280030	10	3,252	5,100	510	325	1,568	24,104
280066	31	10,491	14,332	462	338	1,366	19,255
280074	20	4,436	1,400	70	222	316	19,347
280088	12	5,107	10,800	900	426	2,115	23,257
280099	19	6,203	4,290	226	326	692	23,099
280106	39	11,745	14,420	370	301	1,228	20,486

Table 11. Continuation

Field_Unit_code	Area	Water	Value Pdn	JD/dunum	M3/dunum	JD/1000 m3	JVA Bill
280115	20	6,329	6,625	331	316	1,047	16,500
280124	40	12,941	16,400	410	324	1,267	16,142
280133	40	13,023	18,200	455	326	1,398	28,608
280138	40	12,982	22,200	555	325	1,710	22,300
280179	25	9,309	4,665	187	372	501	19,213
280186	40	11,440	21,800	545	286	1,906	21,847
280229	40	17,024	96,000	2,400	426	5,639	17,659
280231	60	19,896	8,400	140	332	422	15,340
280232	35	11,467	6,300	180	328	549	18,440
290002	16.5	3,829	17,850	1,082	232	4,662	28,509
290019	32	31,808	12,722	398	994	400	21,448
290021	30	7,765	14,300	477	259	1,842	20,926
290039	30	10,245	3,000	100	342	293	17,863
290046	44	8,814	24,630	560	200	2,794	24,816
290051	7	6,958	19,920	2,846	994	2,863	24,750
290066	47	46,718	20,102	428	994	430	8,716
290070	40	39,760	36,388	910	994	915	21,606
290092	25	7,039	4,250	170	282	604	22,040
290102	22	7,513	2,200	100	342	293	21,723
290124	8	3,081	24,960	3,120	385	8,102	12,805
290137	21	8,573	70,800	3,371	408	8,259	#N/A
290165	23	4,365	4,500	196	190	1,031	22,352
290168	50	49,700	52,185	1,044	994	1,050	46,325
290184	1.5	578	3,750	2,500	385	6,492	22,841
290199	25	9,708	66,300	2,652	388	6,830	3,013
290201	31	10,606	51,330	1,656	342	4,840	-
290204	20	8,390	47,875	2,394	420	5,706	25,306
290216	17	7,235	51,000	3,000	426	7,049	12,790
290241	58	11,717	33,200	572	202	2,833	21,160
290254	45	44,730	12,075	268	994	270	2,398
290287	16	3,048	5,280	330	191	1,732	19,098
290290	37	36,778	20,955	566	994	570	17,172
290295	10	3,306	9,640	964	331	2,916	21,562
290354	28	9,562	10,080	360	342	1,054	14,123
290355	10	1,636	18,000	1,800	164	11,005	#N/A
300017	45	11,917	11,325	252	265	950	14,770
300046	40	6,635	12,600	315	166	1,899	-
300048	30	5,646	12,000	400	188	2,125	1,646
300064	30	4,977	13,500	450	166	2,713	18,567
300066	30	4,977	13,500	450	166	2,713	13,616
300098	25	5,437	7,000	280	217	1,287	480
310039	18	5,151	3,230	179	286	627	1,198
310047	10	17,974	5,250	525	1,797	292	1,823
310068	5	1,638	1,400	280	328	855	344
310107	10	17,974	5,250	525	1,797	292	2,345
310111	20	21,168	8,500	425	1,058	402	1,891
310123	13	15,067	2,400	185	1,159	159	2,905
310174	15	26,961	4,500	300	1,797	167	2,957
310235	10	17,974	3,750	375	1,797	209	#N/A
320478	8	4,045	1,200	150	506	297	#N/A
330003	45	33,804	14,600	324	751	432	45,036
330025	36	5,925	11,520	320	165	1,944	9,816
330031	39	29,297	19,385	497	751	662	12,414
330037	29	21,785	24,720	852	751	1,135	18,426

Table 11. Continuation

Field_Unit_code	Area	Water	Value Pdn	JD/dunum	M3/dunum	JD/1000 m3	JVA Bill
330051	14	10,517	3,990	285	751	379	9,415
330069	36	23,724	6,755	188	659	285	14,993
330071	47	35,306	22,750	484	751	644	#N/A
330080	11	8,263	526	48	751	64	11,244
330105	32	24,038	1,870	58	751	78	15,518
330111	24	18,029	1,958	82	751	109	7,268
330125	40	30,048	13,080	327	751	435	19,210
330130	30	41,688	9,600	320	1,390	230	#N/A
330133	27	31,900	7,770	288	1,181	244	16,593
340006	22	16,526	2,820	128	751	171	6,954
340038	26	20,808	17,700	681	800	851	13,836
340072	25	4,802	3,440	138	192	716	9,341
350006	26	19,531	4,130	159	751	211	17,099
350011	24	18,029	4,724	197	751	262	22,086
350015	40	30,048	17,650	441	751	587	9,268
360023	37	3,229	1,776	48	87	550	6,627
360032	26	7,591	10,010	385	292	1,319	11,433
360039	39	7,379	2,300	59	189	312	5,831
360043	30	19,216	4,130	138	641	215	18,742
360047	55	9,625	3,774	69	175	392	10,668
360059	60	11,352	5,035	84	189	444	9,979
360070	11	8,263	3,108	283	751	376	8,964
360081	20	8,385	3,900	195	419	465	7,404
360087	37	19,237	9,975	270	520	519	17,927
360092	28	27,044	13,480	481	966	498	16,657
370008	16	2,347	1,080	68	147	460	13,716
380001	10	1,897	1,725	173	190	910	12,345
380010	30	12,577	2,172	72	419	173	23,384
380012	25	27,079	15,810	632	1,083	584	22,665
380017	13	9,766	3,330	256	751	341	10,950
390009	18	25,013	81,000	4,500	1,390	3,238	6,543
390012	40	55,584	120,400	3,010	1,390	2,166	7,981
490077	40	8,873	6,250	156	222	704	#N/A
530013	56	24,020	21,550	385	429	897	20,216
530017	37	4,184	1,628	44	113	389	-
530023	13	12,922	25,480	1,960	994	1,972	29,009
530038	18	6,147	6,480	360	342	1,054	23,100
540003	35	7,586	14,000	400	217	1,846	875
540035	58	12,182	39,480	681	210	3,241	15,715
540069	40	16,213	102,640	2,566	405	6,331	453
540076	35	34,790	21,875	625	994	629	#N/A
Grand Total	**13,134**	**6,685,307**	**7,347,708**	**559**	**509**	**1,099**	#N/A



Figue 11. Farm Water Needs and Water Bills. Jordan Valley, 2002-2003

Table 12. Area planted by each survey sample farm, by crop category. Jordan Valley, 2002-2003

Table: 12. Area Planted by each survey sample farm, by crop category.
Jordan Valley, 2002-2003

Zone	(All)

Sum of Area	Cat txt						
Field_Unit_code	Bananas	Citrus	Other Trees	Vegetables	Grand Total	Unit	Trees=1
10002		30			30	10002	1
10003	30	8	4		42	10003	1
10010	10	20			30	10010	1
10030		30			30	10030	1
10045		22	3		25	10045	1
10089		53			53	10089	1
20007		32			32	20007	1
20021		29			29	20021	1
20028		44			44	20028	1
30003		15			15	30003	1
30018		12			12	30018	1
30038		22			22	30038	1
30053		15		15	30	30053	1
30067		32			32	30067	1
30096	8	19			27	30096	1
30103		31			31	30103	1
40037		27			27	40037	1
40044		30			30	40044	1
40050		53			53	40050	1
40073				30	30	40073	0
40085		16		4	20	40085	1
40105		29			29	40105	1
50003		23		6	29	50003	1
50006		30			30	50006	1
50011				30	30	50011	0
50034		30			30	50034	1
50040		28			28	50040	1
50043		57			57	50043	1
50050		31			31	50050	1
50055		30			30	50055	1
50106	40				40	50106	1
50113	30				30	50113	1
50156				32	32	50156	0
60008		30			30	60008	1
60013		13	3		16	60013	1
60019				47	47	60019	0
60021		26			26	60021	1
60030		25			25	60030	1
70025		20	6		26	70025	1
70032				30	30	70032	0
70042		45			45	70042	1
70044		40			40	70044	1
70054		40			40	70054	1
70078		32			32	70078	1
70080				35	35	70080	0
70081		39			39	70081	1
70091		29			29	70091	1
70123		30			30	70123	1

Table 12. Continuation

Sum of Area	Cat txt						
Field_Unit_code	Bananas	Citrus	Other Trees	Vegetables	Grand Total	Unit	Trees=1
70134		30			30	70134	1
70150		35			35	70150	1
80004				16	16	80004	0
80007				42	42	80007	0
80015		10			10	80015	1
80024				19	19	80024	0
80038		29			29	80038	1
80039		29			29	80039	1
80047		25			25	80047	1
80053		33			33	80053	1
80084		30			30	80084	1
80087		49			49	80087	1
90015		22		12	34	90015	1
100007		39			39	100007	1
100008		28			28	100008	1
100010		32			32	100010	1
100013				39	39	100013	0
100018		30		10	40	100018	1
100020				20	20	100020	0
100033		35			35	100033	1
100036		26			26	100036	1
100037		26			26	100037	1
100041		26			26	100041	1
100067		53			53	100067	1
100069		148			148	100069	1
100072				23	23	100072	0
100073		30			30	100073	1
100078		25	5		30	100078	1
100082		29			29	100082	1
100093		26		10	36	100093	1
100098		38			38	100098	1
100099		31			31	100099	1
100109		37			37	100109	1
100120		27			27	100120	1
100129		21			21	100129	1
100131		51			51	100131	1
100169		28			28	100169	1
100185		18			18	100185	1
100203		21			21	100203	1
100218		58	1		59	100218	1
100221		37			37	100221	1
100229		56			56	100229	1
100254		50			50	100254	1
100256		39			39	100256	1
110011		28			28	110011	1
110014		24			24	110014	1
110022		33			33	110022	1
110024		35			35	110024	1
110028		29			29	110028	1
110034		14		12	26	110034	1
110038		29			29	110038	1
110061		27			27	110061	1
110062		28			28	110062	1
110064		18		15	33	110064	1

Table 12. Continuation

Sum of Area	Cat txt						
Field_Unit_code	Bananas	Citrus	Other Trees	Vegetables	Grand Total	Unit	Trees=1
110083		12			12	110083	1
110084				9	9	110084	0
110138		18			18	110138	1
110147		12			12	110147	1
110163		19		3	22	110163	1
110164				31	31	110164	0
110180		17	20		37	110180	1
110192		22			22	110192	1
110209		39			39	110209	1
110246		31			31	110246	1
120063		29			29	120063	1
120070		30			30	120070	1
120093				30	30	120093	0
120108		36			36	120108	1
120158				40	40	120158	0
120159				10	10	120159	0
120168		12	2	8	22	120168	1
120169		25	5		30	120169	1
120172				35	35	120172	0
120204		35			35	120204	1
130009		5		50	55	130009	0
130024				30	30	130024	0
130032		33			33	130032	1
130038		30			30	130038	1
130061				25	25	130061	0
130073		17			17	130073	1
130083				30	30	130083	0
140010		22	23	16	61	140010	1
140028		37			37	140028	1
140038		47			47	140038	1
140047				10	10	140047	0
140110		30			30	140110	1
140111		31			31	140111	1
140113		10		4	14	140113	1
140117		29			29	140117	1
150001	16			25	41	150001	0
150022		31			31	150022	1
150045		28			28	150045	1
150050				28	28	150050	0
150055		34			34	150055	1
150066				16	16	150066	0
150069				25	25	150069	0
150088				28	28	150088	0
150116		40			40	150116	1
160002		25			25	160002	1
160004		39			39	160004	1
160009		16		4	20	160009	1
160022				49	49	160022	0
160024				30	30	160024	0
160038				15	15	160038	0
160047	30	7			37	160047	1
160050	14	10			24	160050	1
160051	10	18			28	160051	1
160058		32			32	160058	1

Table 12. Continuation

Sum of Area	Cat txt						
Field_Unit_code	Bananas	Citrus	Other Trees	Vegetables	Grand Total	Unit	Trees=1
160066				30	30	160066	0
160077				49	49	160077	0
160097				9	9	160097	0
160118				37	37	160118	0
160129				27	27	160129	0
160214	10	3			13	160214	1
170015				63	63	170015	0
170017				50	50	170017	0
170018				34	34	170018	0
170045		28.5			28.5	170045	1
170049				30	30	170049	0
190002				160	160	190002	0
190011				70	70	190011	0
190015		38			38	190015	1
190016		10			10	190016	1
190026		14		32	46	190026	0
190041				36	36	190041	0
190054				46	46	190054	0
190082		32			32	190082	1
190088				32	32	190088	0
190092			6	12	18	190092	0
200001				35	35	200001	0
200009				50	50	200009	0
200054				33	33	200054	0
200069				35	35	200069	0
210004				40	40	210004	0
210041				21	21	210041	0
210063				10	10	210063	0
210169				45	45	210169	0
210186				5.5	5.5	210186	0
210192				46	46	210192	0
210200				70	70	210200	0
210213				34.5	34.5	210213	0
210224				35	35	210224	0
210226				25.5	25.5	210226	0
210232				14	14	210232	0
220036				22.5	22.5	220036	0
220060				20	20	220060	0
220072				17	17	220072	0
220126				30	30	220126	0
220128				30	30	220128	0
220137		24			24	220137	1
220150				8.5	8.5	220150	0
220158				20	20	220158	0
220179				8.5	8.5	220179	0
220192				17	17	220192	0
220200		25			25	220200	1
220212				20	20	220212	0
220243		12	8		20	220243	1
220280				15	15	220280	0
220312		30			30	220312	1
220313		50	65		115	220313	1
220320				55	55	220320	0
220363		54			54	220363	1

Table 12. Continuation

Sum of Area	Cat txt						
Field_Unit_code	Bananas	Citrus	Other Trees	Vegetables	Grand Total	Unit	Trees=1
220364				75	75	220364	0
230008				19	19	230008	0
230038				26	26	230038	0
230064				30	30	230064	0
230081				30	30	230081	0
230129				21	21	230129	0
230143				24	24	230143	0
230227				20	20	230227	0
230228				9	9	230228	0
230232				30	30	230232	0
230233				66.5	66.5	230233	0
230247				15	15	230247	0
230293				13.5	13.5	230293	0
230297				18	18	230297	0
230320				26	26	230320	0
230324				8.5	8.5	230324	0
230345				10	10	230345	0
230371				30	30	230371	0
230398				10	10	230398	0
230399				80	80	230399	0
230423				23	23	230423	0
230431				25	25	230431	0
230436				33	33	230436	0
230452				32	32	230452	0
230479				23	23	230479	0
230483				30	30	230483	0
230486				30	30	230486	0
230487				30	30	230487	0
230544				13	13	230544	0
230546				46	46	230546	0
230648				35	35	230648	0
230657				35	35	230657	0
240031				32	32	240031	0
240063				28	28	240063	0
240067			30		30	240067	1
240079				40	40	240079	0
240103				49	49	240103	0
250016				30	30	250016	0
250022				20	20	250022	0
250024				30	30	250024	0
250040				20	20	250040	0
250050				5.4	5.4	250050	0
250064				30	30	250064	0
250076				20.5	20.5	250076	0
250086				19	19	250086	0
250101				18	18	250101	0
250112			31		31	250112	1
250158				42	42	250158	0
250169				28	28	250169	0
250191				40	40	250191	0
250200				31	31	250200	0
250239				47	47	250239	0
250270				37	37	250270	0
250281				30	30	250281	0

Table 12. Continuation

Sum of Area	Cat txt							
Field_Unit_code	Bananas	Citrus	Other Trees	Vegetables	Grand Total	Unit	Trees=1	
250288				30	30	250288	0	
250310				50	50	250310	0	
250360				25	25	250360	0	
250365				27	27	250365	0	
250368				30	30	250368	0	
250410			25	10	35	250410	1	
250428				30	30	250428	0	
260025				52	52	260025	0	
260030				35	35	260030	0	
260046				61	61	260046	0	
260050				24	24	260050	0	
260070				80	80	260070	0	
260080				38	38	260080	0	
260125				40	40	260125	0	
260126				40	40	260126	0	
260127				40	40	260127	1	
260168				45	45	260168	0	
260200				30	30	260200	0	
260205				35	35	260205	0	
260210				45	45	260210	0	
260217				40	40	260217	0	
260225				40	40	260225	0	
260239				20	20	260239	0	
260246				40	40	260246	0	
260248				36	36	260248	0	
260259				21.5	21.5	260259	0	
260292				30	30	260292	0	
260294				60	60	260294	0	
260304				32	32	260304	0	
270014				16	16	270014	0	
270035				35	35	270035	0	
270080				28	28	270080	0	
270087				25	25	270087	0	
270108				10	24	34	270108	0
270110				35	35	270110	0	
270124				31	31	270124	0	
270125				40	40	270125	0	
270130				28	28	270130	0	
270140				36	36	270140	0	
270185				40	40	270185	0	
270195				40	40	270195	0	
270217				7	7	270217	0	
270219				43	43	270219	0	
270222				25	25	270222	0	
270254				15	15	270254	0	
270268				10	10	270268	0	
270271				20	20	270271	0	
270296				5	5	270296	0	
270319				20	20	270319	0	
270321				24	24	270321	0	
270378				38	38	270378	0	
270384				30	30	60	270384	1
270427				20	20	270427	0	
280015				55	55	280015	0	

Table 12. Continuation

Sum of Area	Cat txt						
Field_Unit_code	Bananas	Citrus	Other Trees	Vegetables	Grand Total	Unit	Trees=1
280030				10	10	280030	0
280066				31	31	280066	0
280074				20	20	280074	0
280088				12	12	280088	0
280099				19	19	280099	0
280106				39	39	280106	0
280115				20	20	280115	0
280124				40	40	280124	0
280133				40	40	280133	0
280138				40	40	280138	0
280179				25	25	280179	0
280186				40	40	280186	0
280229				40	40	280229	0
280231				60	60	280231	0
280232				35	35	280232	0
290002				16.5	16.5	290002	0
290019		32			32	290019	1
290021				30	30	290021	0
290039				30	30	290039	0
290046				44	44	290046	0
290051		4	3		7	290051	1
290066		47			47	290066	1
290070		40			40	290070	1
290092				25	25	290092	0
290102				22	22	290102	0
290124				8	8	290124	0
290137				21	21	290137	0
290165				23	23	290165	0
290168		50			50	290168	1
290184				1.5	1.5	290184	0
290199				25	25	290199	0
290201				31	31	290201	0
290204				20	20	290204	0
290216				17	17	290216	0
290241				58	58	290241	0
290254		45			45	290254	1
290287				16	16	290287	0
290290		37			37	290290	1
290295				10	10	290295	0
290354				28	28	290354	0
290355				10	10	290355	0
300017				45	45	300017	0
300046				40	40	300046	0
300048				30	30	300048	0
300064				30	30	300064	0
300066				30	30	300066	0
300098				25	25	300098	0
310039				18	18	310039	0
310047	10				10	310047	1
310068				5	5	310068	0
310107	10				10	310107	1
310111	10			10	20	310111	1
310123		6	7		13	310123	1
310174	15				15	310174	1

Table 12. Continuation

Sum of Area	Cat txt						
Field_Unit_code	Bananas	Citrus	Other Trees	Vegetables	Grand Total	Unit	Trees=1
310235	10				10	310235	1
320478				8	8	320478	0
330003			45		45	330003	1
330025				36	36	330025	0
330031		24	15		39	330031	1
330037		29			29	330037	1
330051		14			14	330051	1
330069		26	5	5	36	330069	1
330071		47			47	330071	1
330080		11			11	330080	1
330105		12	20		32	330105	1
330111			24		24	330111	1
330125		40			40	330125	1
330130	30				30	330130	1
330133	20	4	1	2	27	330133	1
340006		22			22	340006	1
340038	2	24			26	340038	1
340072				25	25	340072	0
350006		26			26	350006	1
350011		24			24	350011	1
350015		40			40	350015	1
360023				37	37	360023	0
360032				26	26	360032	0
360039				39	39	360039	0
360043			25	5	30	360043	1
360047				55	55	360047	0
360059				60	60	360059	0
360070		4	7		11	360070	1
360081			10	10	20	360081	1
360087		20		17	37	360087	1
360092	18			10	28	360092	1
370008				16	16	370008	0
380001				10	10	380001	0
380010		15		15	30	380010	1
380012	13	12			25	380012	1
380017		10	3		13	380017	1
390009	18				18	390009	1
390012	40				40	390012	1
490077				40	40	490077	0
530013			15	41	56	530013	0
530017				37	37	530017	0
530023			13		13	530023	1
530038				18	18	530038	0
540003				35	35	540003	0
540035				58	58	540035	0
540069				40	40	540069	0
540076		35			35	540076	1
Grand Total	394	4803.5	434	7502.9	13134.4		

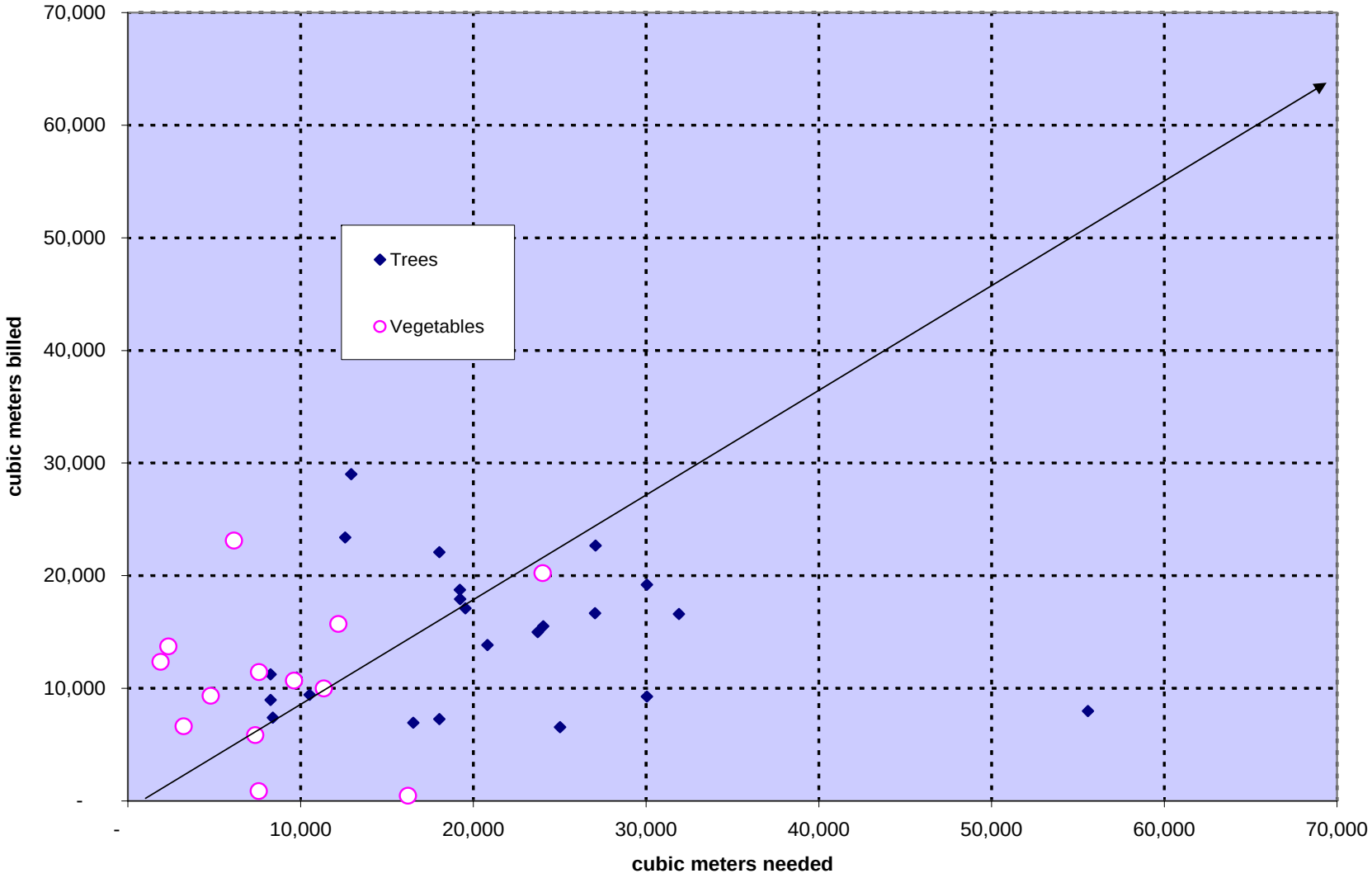


Figure 12. Water Needs and Water Bills for Vegetable and Tree farms in Jordan Valley, 2002-2003

Table 13. Regression Summary Results: JVA Water bills and Farm Cropping Pattern, Jordan Valley Farm Survey, 2002-2003. Equation with zero intercept.

Table 13. Regression Summary Results: JVA Water bills and Farm Cropping Pattern.
Jordan Valley Farm Survey, 2002-2003
Equation with zero intercept

Regression Statistics	
Multiple R	65,535.00
R Square	(0.11)
Adjusted R	(0.12)
Standard E	9,720.25
Observatio	383

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regressior	4	-3.59E+09	-8.98E+08	(9.51)	#NUM!
Residual	379	3.581E+10	94483346		
Total	383	3.222E+10			

	Coefficients	*tandard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A
Bananas	867	107	8.10	0	656	1,077
Citrus	487	24	20.25	0	440	534
Other Tree	640	121	5.30	0	402	877
Vegetables	446	19	23.52	0	409	484

RESIDUAL OUTPUT

Observation	*redicted JVA ı*	*Trees*	*Vegetables*
1	14,606	24,610	#N/A
2	32,458	54,444	#N/A
3	18,406	26,077	#N/A
4	14,606	19,405	#N/A
5	12,630	25,620	#N/A
6	25,804	25,230	#N/A
7	15,580	22,202	#N/A
8	14,119	14,880	#N/A
9	7,303	9,586	#N/A
10	5,842	12,699	#N/A
11	10,711	16,218	#N/A
12	15,580	16,264	#N/A
13	16,185	18,007	#N/A
14	15,093	15,670	#N/A
15	13,146	18,002	#N/A
16	14,606	20,340	#N/A
17	25,804	16,956	#N/A
18	13,387	#N/A	9,666
19	9,575	15,905	#N/A
20	14,119	15,578	#N/A
21	13,875	16,191	#N/A
22	14,606	20,461	#N/A
23	13,387	#N/A	14,958
24	14,606	22,968	#N/A
25	13,632	18,115	#N/A
26	27,752	33,834	#N/A
27	15,093	15,599	#N/A
28	14,606	23,256	#N/A
29	34,673	49,727	#N/A
30	26,005	57,461	#N/A

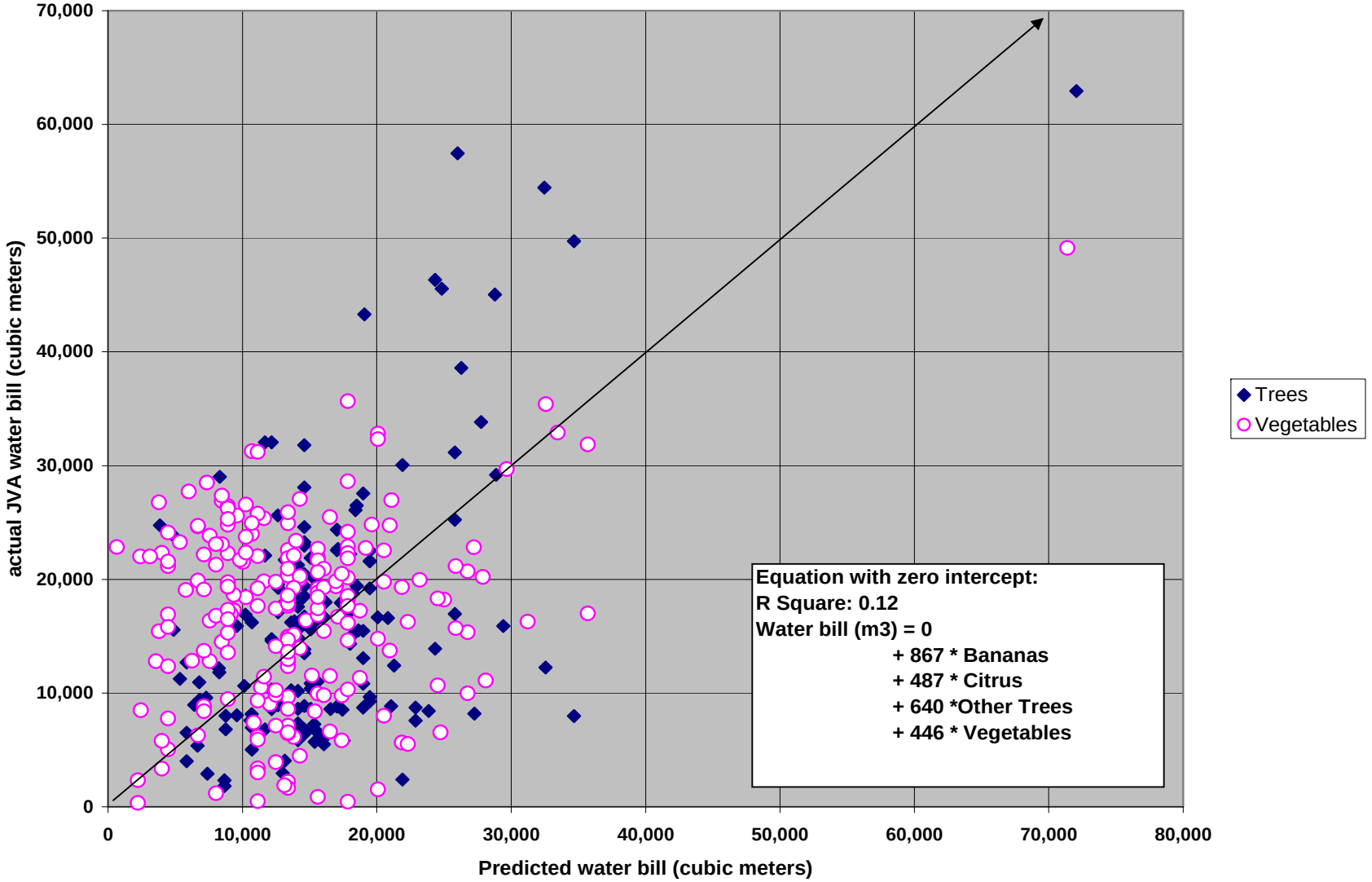


Figure 13. Predicted water bills based on crop pattern and actual JVA water bills, 2002-2003

Table 14. Regression Summary Results: JVA Water bills and Farm Cropping Pattern, Jordan Valley Farm Survey, 2002-2003. Equation with non-zero intercept.

Table 14. Regression Summary Results: JVA Water Bills and Farm Cropping Patterns
Jordan Valley Farm Survey, 2002-2003
Equation with non-zero intercept

Regression Statistics	
Multiple R	0.38
R Square	0.15
Adjusted R Square	0.14
Standard Error	8,533
Observations	383

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	4	4696305521	1.174E+09	16.13	3.33E-12
Residual	378	27520325307	72805093		
Total	382	32216630828			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	10,408	975	10.7	2.07E-23	8,490	12,326
Bananas	509	100	5.1	5.31E-07	313	705
Citrus	214	33	6.5	3.05E-10	149	280
Other Trees	352	109	3.2	0.001399	137	567
Vegetables	187	29	6.3	7.04E-10	129	245

RESIDUAL OUTPUT

Observation	*Predicted JVA m3*	*Residuals*	*Trees*	*Vegetables*
1	16,839	7,771	24,610	#N/A
2	28,798	25,646	54,444	#N/A
3	19,784	6,293	26,077	#N/A
4	16,839	2,566	19,405	#N/A
5	16,179	9,441	25,620	#N/A
6	21,769	3,461	25,230	#N/A
7	17,267	4,935	22,202	#N/A
8	16,624	(1,744)	14,880	#N/A
9	13,623	(4,037)	9,586	#N/A
10	12,980	(281)	12,699	#N/A
11	15,124	1,094	16,218	#N/A
12	17,267	(1,003)	16,264	#N/A
13	18,552	(545)	18,007	#N/A
14	17,053	(1,383)	15,670	#N/A
15	16,196	1,806	18,002	#N/A
16	16,839	3,501	20,340	#N/A
17	21,769	(4,813)	16,956	#N/A
18	16,005	(6,339)	#N/A	9,666
19	14,584	1,321	15,905	#N/A
20	16,624	(1,046)	15,578	#N/A
21	16,458	(267)	16,191	#N/A
22	16,839	3,622	20,461	#N/A
23	16,005	(1,047)	#N/A	14,958
24	16,839	6,129	22,968	#N/A
25	16,410	1,705	18,115	#N/A
26	22,626	11,208	33,834	#N/A
27	17,053	(1,454)	15,599	#N/A
28	16,839	6,417	23,256	#N/A
29	30,766	18,961	49,727	#N/A
30	25,676	31,785	57,461	#N/A

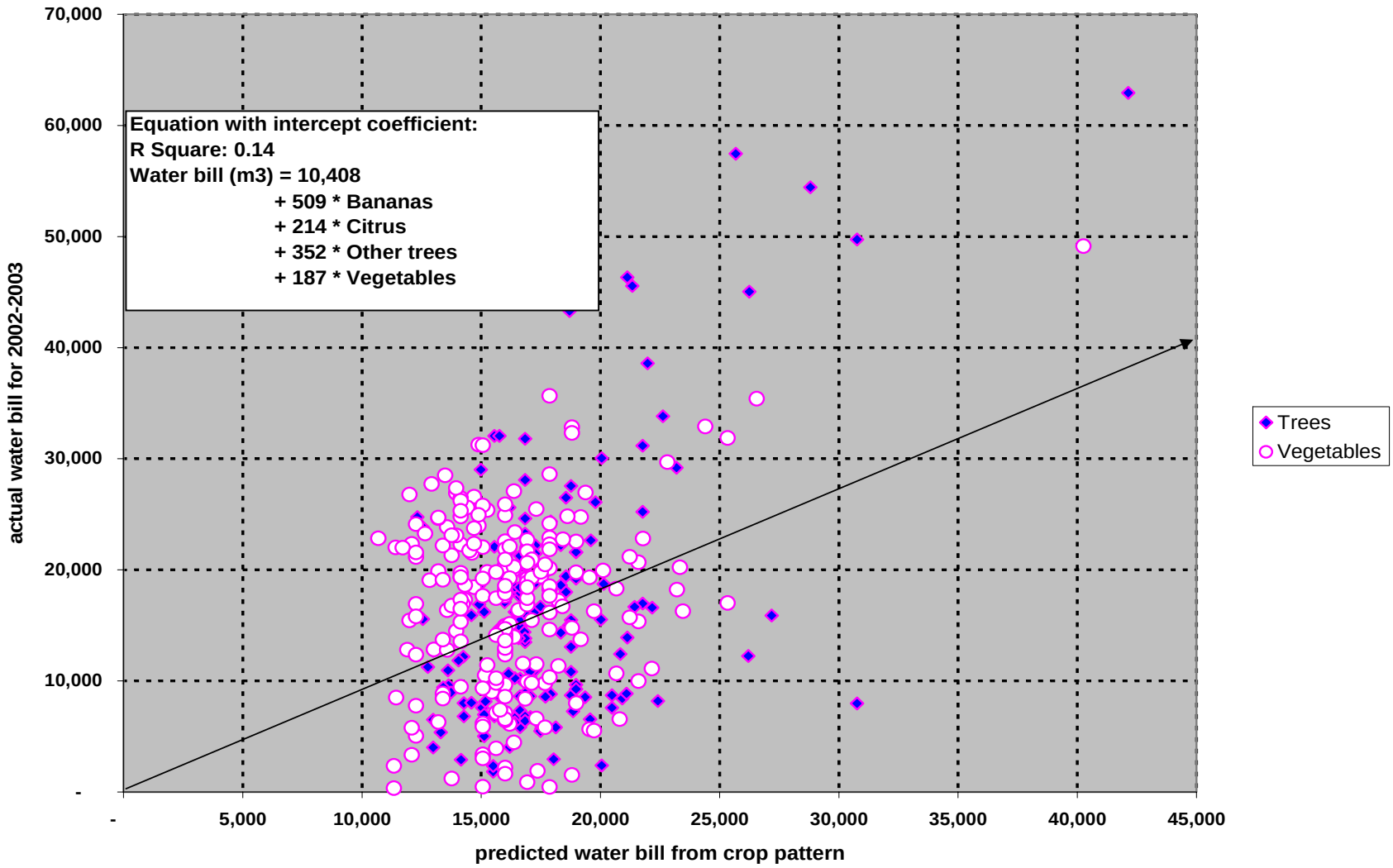


Figure 14. Predicted water needs from regression equation and actual JVA water bills for survey sample vegetable and tree farms in Jordan Valley, 2002-2003

Table 15. Deductions for Amortization of Initial Cost of Investments for Greenhouses and Establishment of Citrus Orchards.

Table 15. Deductions for Amortization of Initial Cost of Investments for Greenhouses and Establishment of Citrus Orchards

12% rate of interest

Cost of Greenhouse for Vegetables in 2002-2003

1,000	Initial cost of metal framework for greenhouses in 2002-2003
10	years to amortize
($176.98)	annual amortization payment for metal frames
200	Initial cost of plastic covers for greenhouses in 2002-2003
3	years to amoritize plastic covers
($83.27)	annual amortization payment for plastic covers
($260)	total annual amortization for greenhouses

Cost of Greenhouse for Vegetables in 2004-2005

1,300	Initial cost of metal framework for greenhouses in 2004-2005
($230.08)	annual amortization payment for metal frames
300	Initial cost of plastic covers for greenhouses in 2004-2005
($124.90)	annual amortization payment for plastic covers
($354.98)	Total annual amortization for greenhouses

Cost of Establishing a Citrus Orchard

	Outlays	Cumulative with interest
Year 1	**303**	
Year 2	**114**	**453**
Year 3	**114**	**622**
Year 4	**114**	**810**
Year 5		**908**

20	Years to amortize initial investment
($122)	Annual amortization payment for establishment cost

Cost of Establishing a Banana Field

483	Initial cost of establishing a field of bananas
10	years to amortize establishment cost
($85)	Annual amortization for establishment cost of bananas

Table 16. Area, Water, and Revenue by Crop Category, and Farming System.

Table 16. Area, Water, and Revenue by Crop Category and farming system

Zone	(All)

	Cat txt				
Data	Bananas	Citrus	Other Trees	Vegetables	Grand Total
Sum of Area	394	4,804	434	7,503	13,134
Sum of Water	569,931	3,776,078	390,635	1,948,663	6,685,307
Sum of Revenue	374,645	1,710,827	70,592	4,270,691	6,426,754

Same data as above but per dunum

	Bananas	Citrus	Other Trees	Vegetables	Grand Total
JD/dunum	951	356	163	569	489
M3/dunum	1,447	786	900	260	509
JD/1000 M3	657	453	181	2,192	961

DA_Zone	(All)

Sum of Area	Farming				
Cat txt	1	2	3	4	Grand Total
Bananas	394				394
Citrus	4,804				4,804
Other Trees	434				434
Vegetables	6,456	83	867	97	7,503
Grand Total	12,088	83	867	97	13,134

Zone	(All)

Sum of Revenue	Farming				
Cat txt	1	2	3	4	Grand Total
Bananas	374,645				374,645
Citrus	1,710,827				1,710,827
Other Trees	70,592				70,592
Vegetables	2,235,309	53,100	1,829,630	152,652	4,270,691
Grand Total	4,391,372	53,100	1,829,630	152,652	6,426,754

	Bananas	Citrus	Other Trees	- Open Field	astic Tunnel	- Green House	ples - Multispan
Area Planted	394	4,804	434	6,456	83	867	97

	Bananas	Citrus	Other Trees	- Open Field	astic Tunnel	- Green House	ples - Multispan
Revenue per dun	951	356	163	346	640	2,110	1,575

Zone	(All)

Sum of Value Pd	Farming				
Cat txt	1	2	3	4	Grand Total
Bananas	408,325				408,325
Citrus	2,294,506				2,294,506
Other Trees	123,328				123,328
Vegetables	2,235,309	53,100	2,055,270	177,871	4,521,550
Grand Total	5,061,467	53,100	2,055,270	177,871	7,347,708

Per dunum

	Bananas	Citrus	Other Trees	- Open Field	astic Tunnel	- Green House	ples - Multispan
Value Production	1,036	478	284	346	640	2,371	1,836

Zone	(All)

Sum of Water	Farming				
Cat txt	1	2	3	4	Grand Total
Bananas	569,931				569,931
Citrus	3,776,078				3,776,078
Other Trees	390,635				390,635
Vegetables	1,520,681	33,987	353,674	40,321	1,948,663
Grand Total	6,257,326	33,987	353,674	40,321	6,685,307

	Bananas	Citrus	Other Trees	- Open Field	astic Tunnel	- Green House	ples - Multispan
m3/dunum	1,447	786	900	236	409	408	416

	Bananas	Citrus	Other Trees	- Open Field	astic Tunnel	- Green House	ples - Multispan
Value per 1000 n	716	608	316	1,470	1,562	5,811	4,411
Revenue per 100	657	453	181	1,470	1,562	5,173	3,786

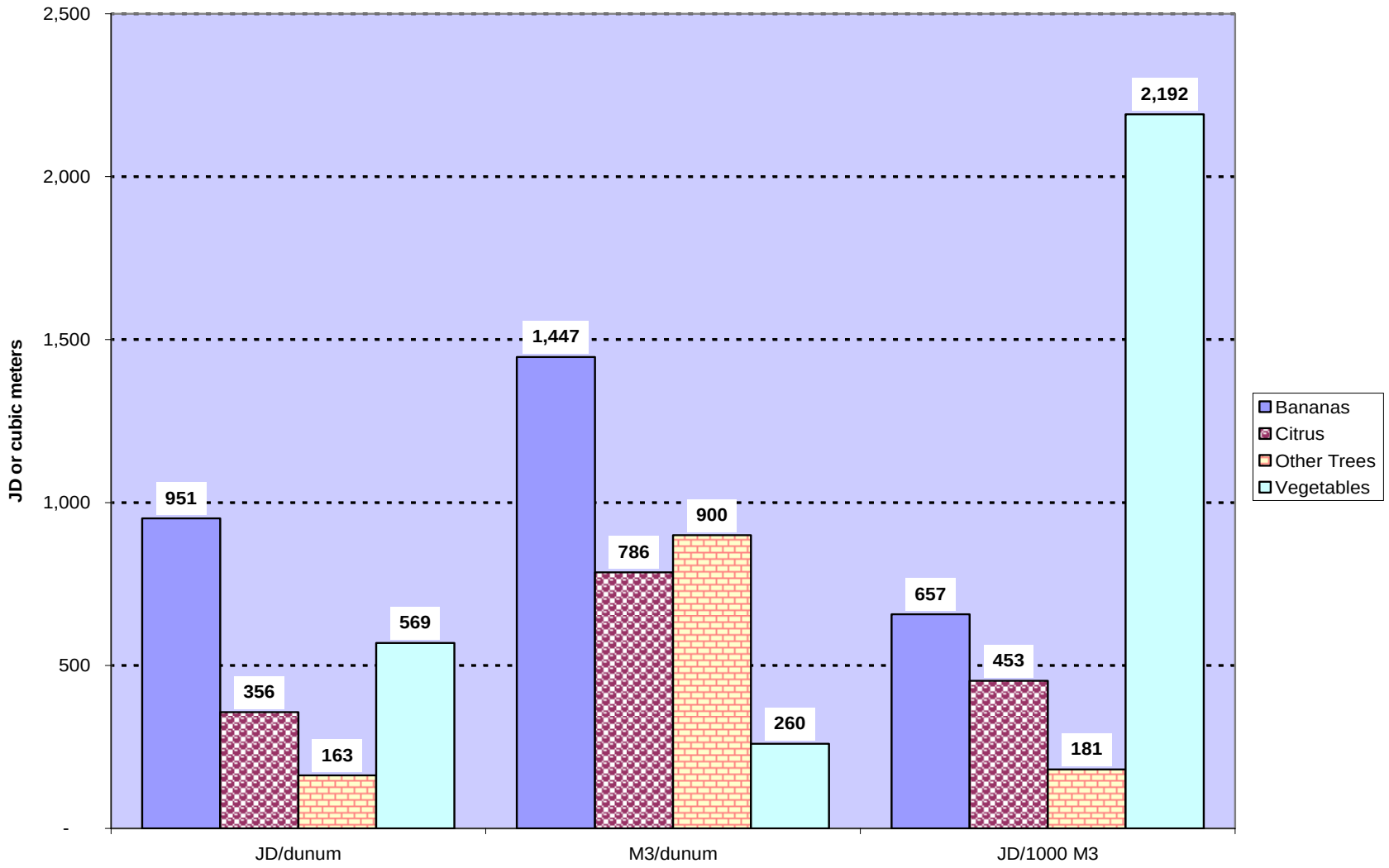


Figure 16-a. Gross Revenue (after deductions for initial investment) per dunum, Water Needs and Revenue per 1000 m3 of water. Jordan Valley, 2002-2003

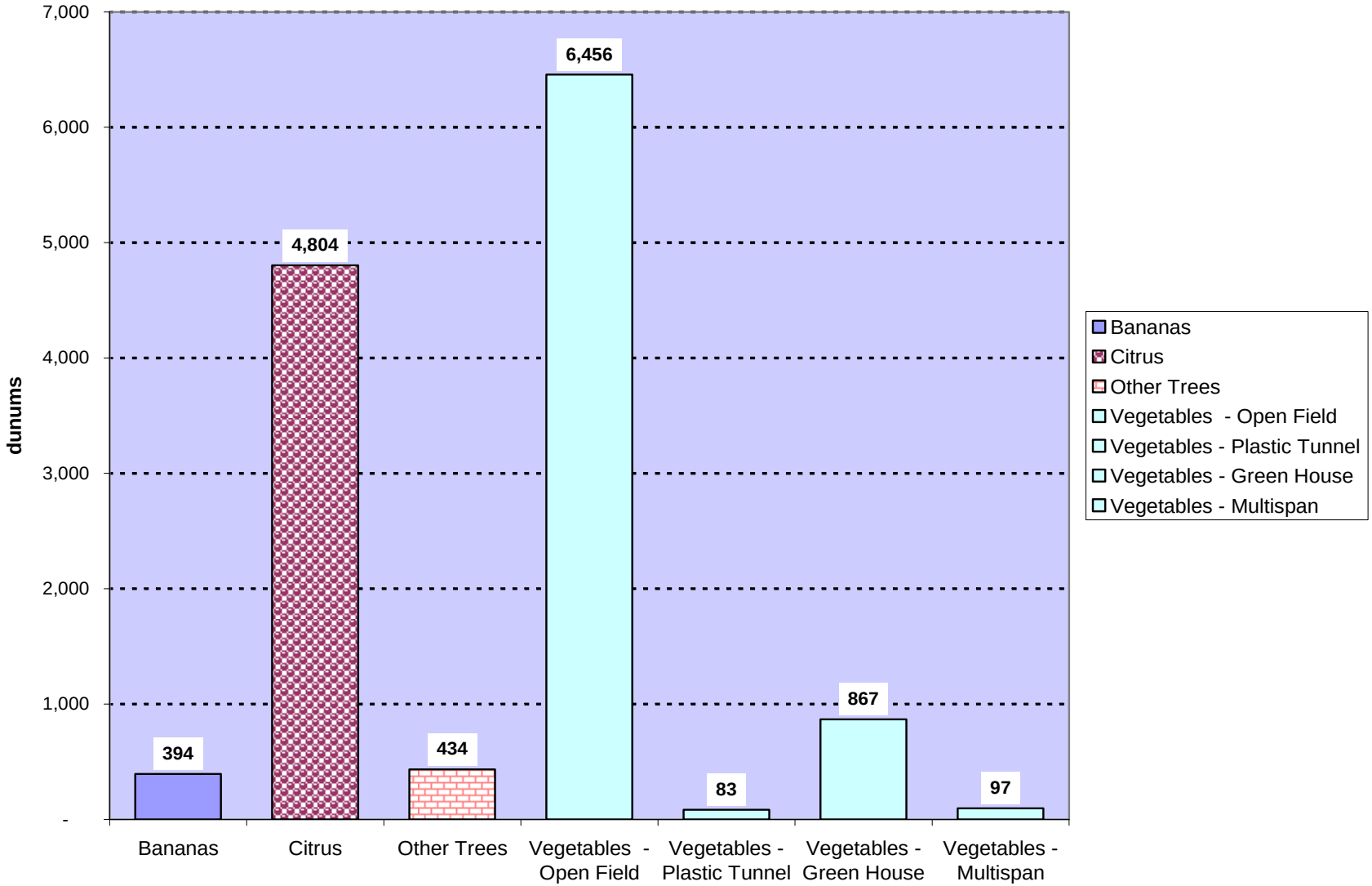


Figure 16-b. Area Planted by crop category and farming system. Jordan Valley, 2002-2003

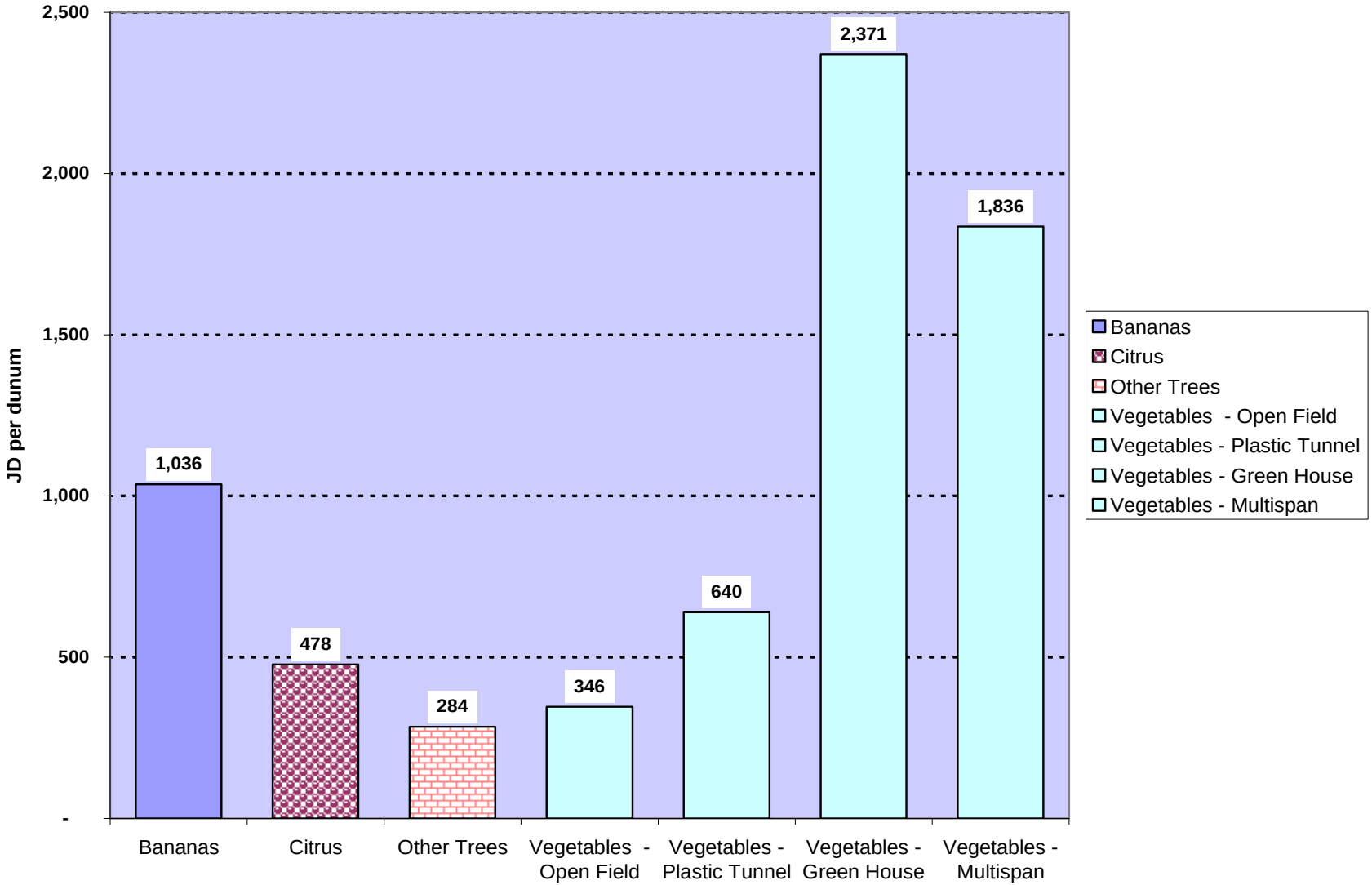


Figure 16-c. Value of Production per dunum by crop category and farming system. Jordan Valley, 2002-2003

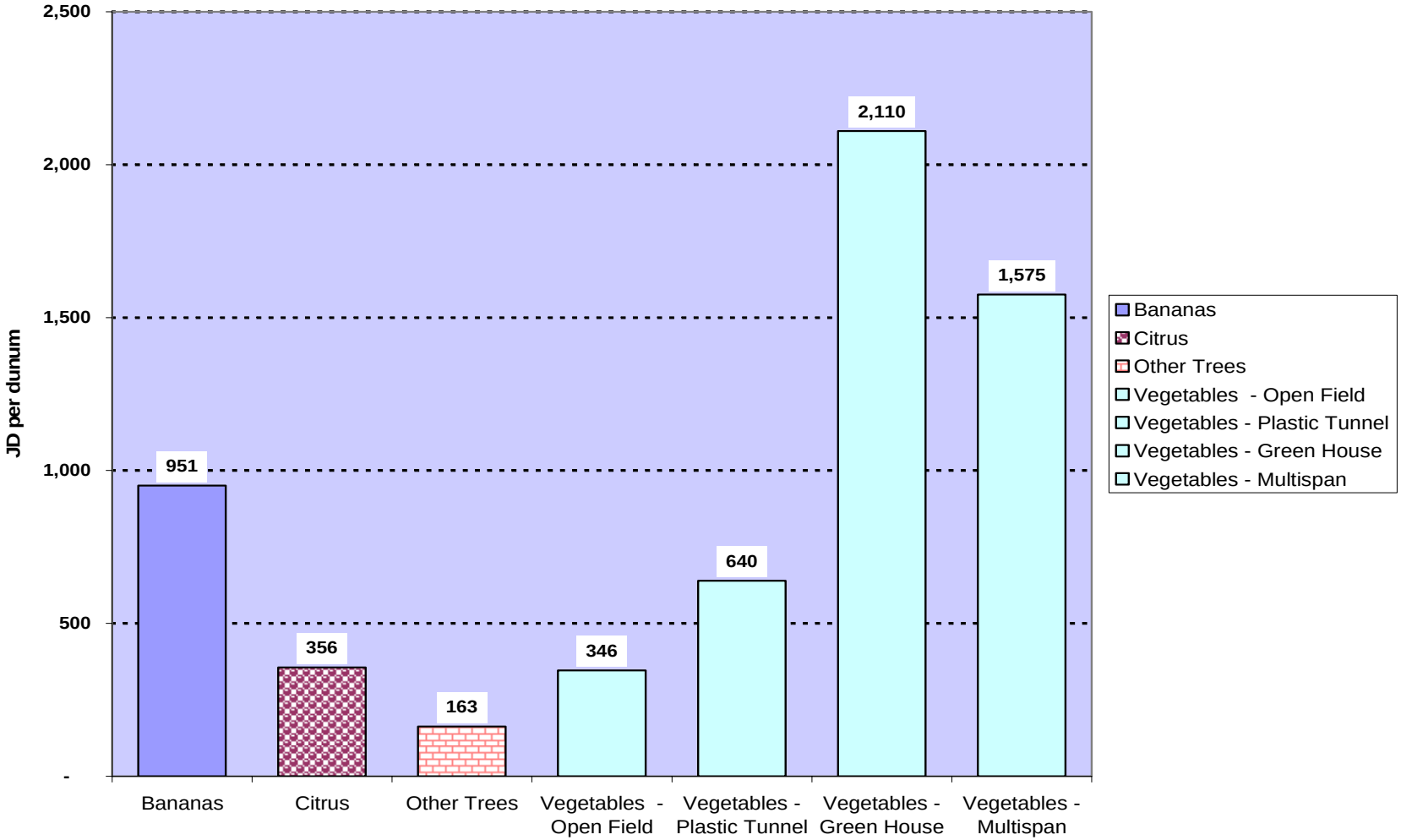


Figure 16 d. Gross Revenue, after deductions for initial investment, per dunum, by crop category and farming system in the JV.

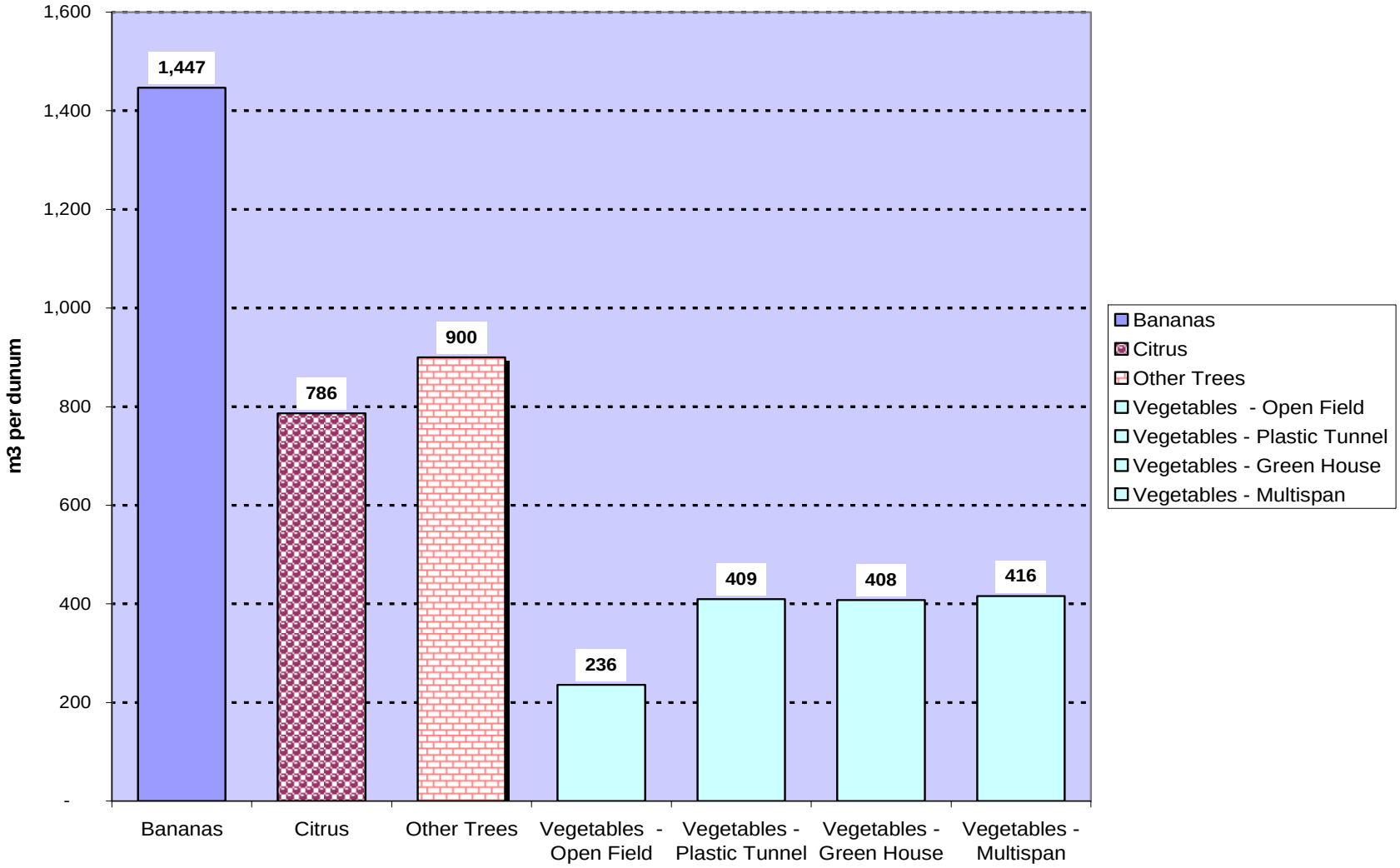


Figure 16-e. Water Needs per dunum by crop category and farming system. Jordan Valley, 2002=2003

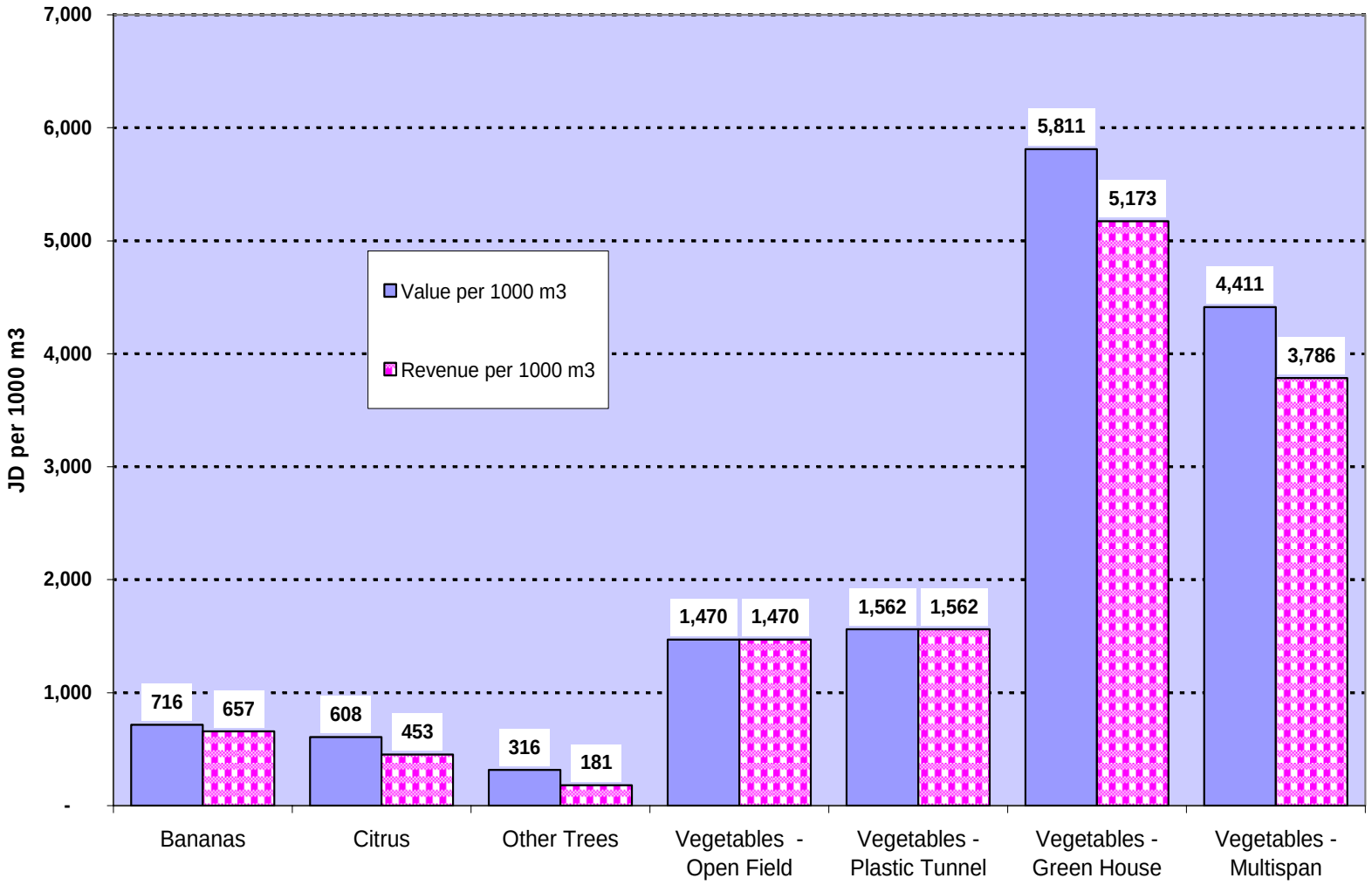


Figure 16-f. Value of Production and Gross Revenue after deductions for investment, per 1000 m3 of water, by crop category and farming type. Jordan Valley, 2002-2003