TREATED WASTEWATER REUSE IN THE WEST BANK: PROSPECTS, CHALLENGES AND CONSTRAINTS

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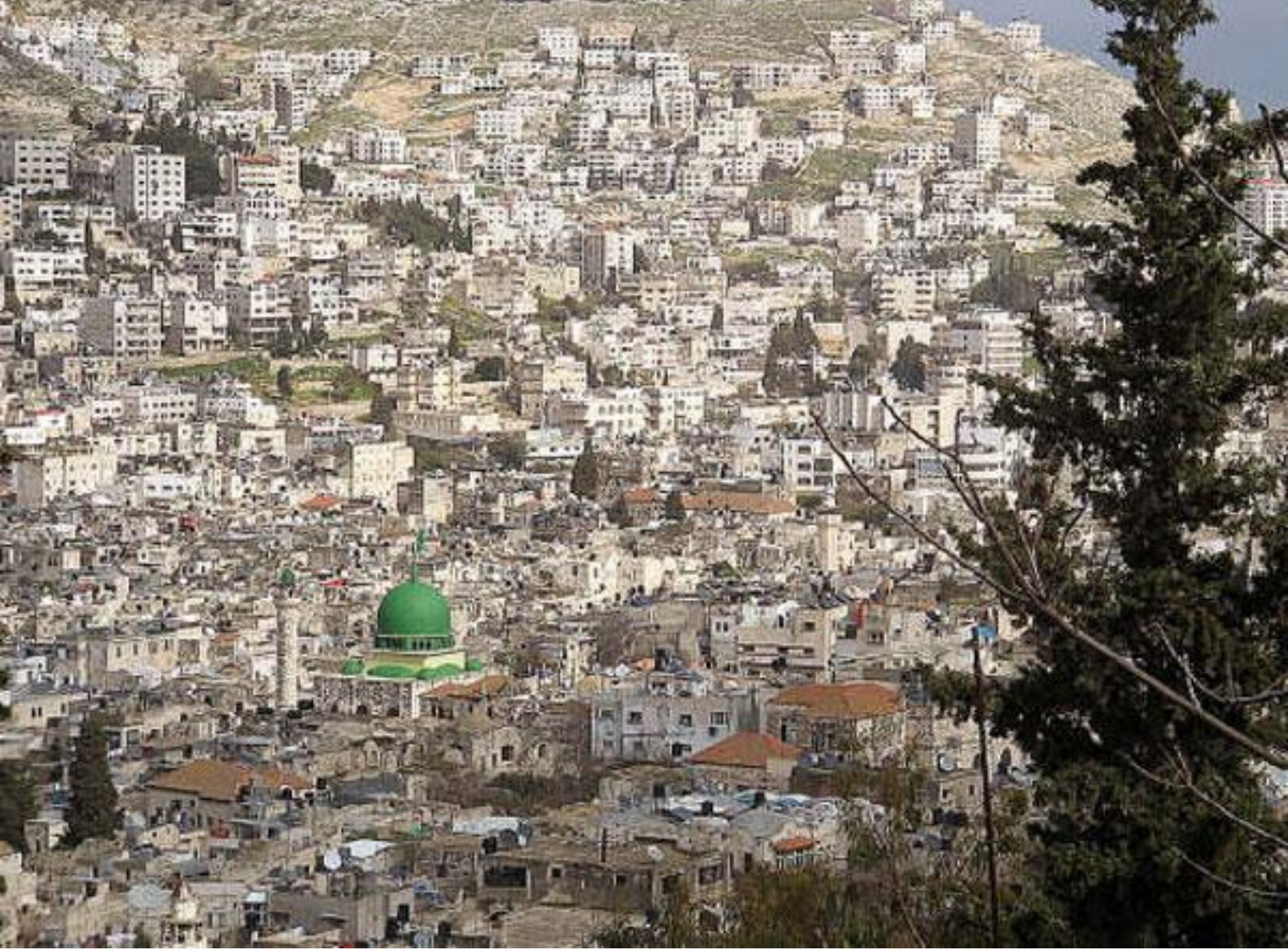
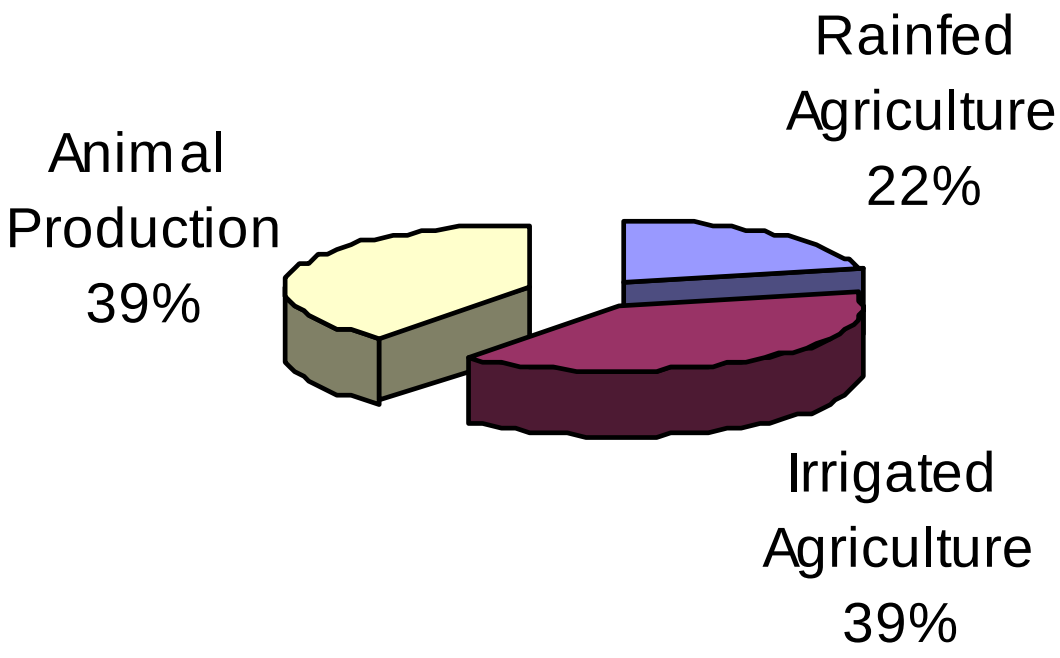


Importance of agriculture in WB

- Contribution in GDP:
  - 30% in 1960's
  - 5.3% in 2010
- Contribution to labor force:
  - 43% in 1960's
  - 13% in the last 10 years

Value of Agricultural Production in Palestine

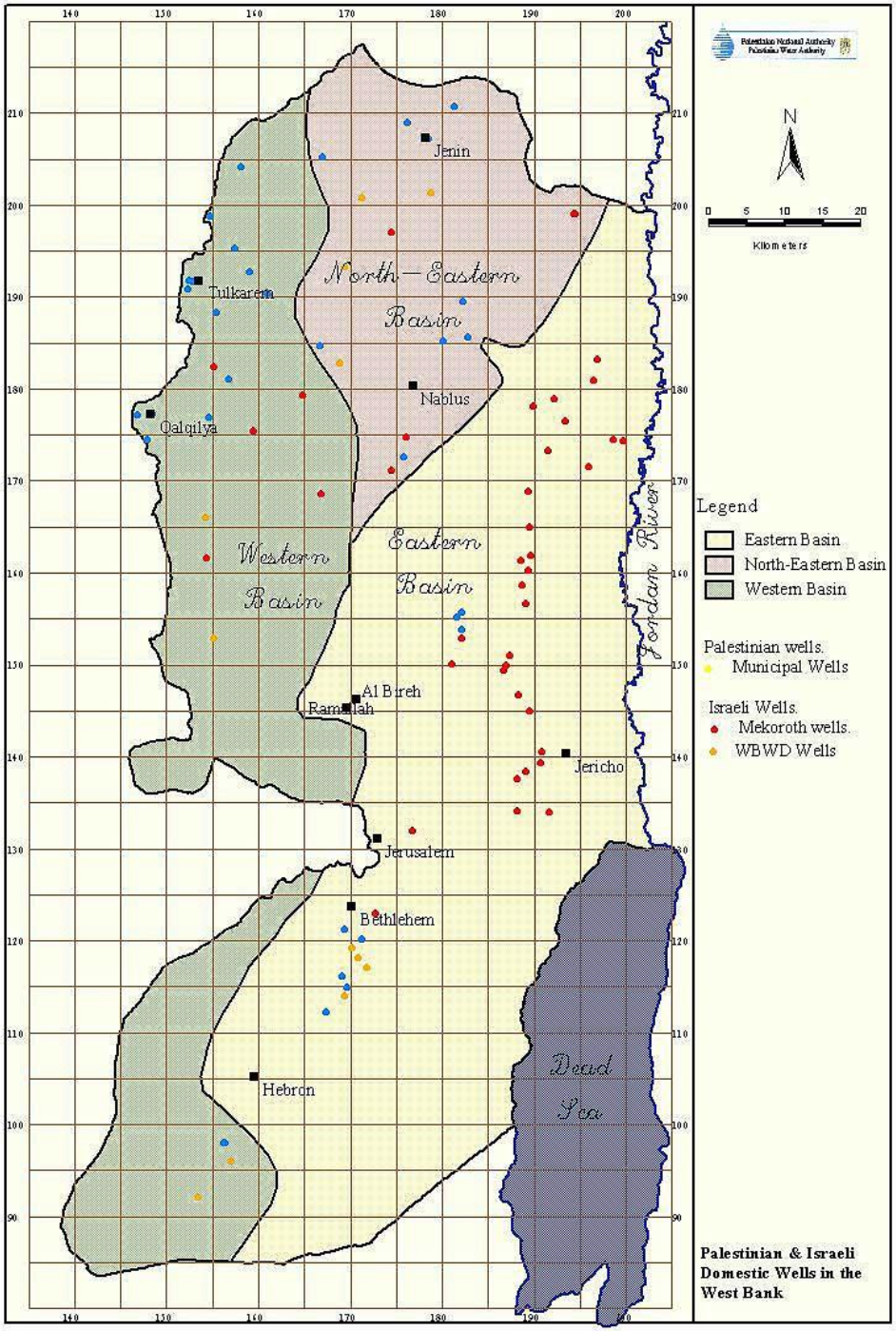


Land availability

- One third of WB lands is suitable for agricultural cultivation
- Only 11% is suitable for irrigated agriculture (610,000 dunums)
- Only 130,000 dunums are irrigated
- Limitation of water supplies

Water supply and water use

- Groundwater: natural recharge 648 mcm/a to three main aquifer basins
- Use:
  - Domestic sector: 96 mcm/a
  - Agriculture: dropped from 90-100 mcm/a to about 60-70 mcm/a recently
  - Diversion to domestic sector, drying up of springs


Palestinian National Authority
Palestinian Water Authority
N
0 5 10 15 20
Kilometers
Jenin
Tulkarem
Qalqilya
Nablus
North – Eastern Basin
Western Basin
Eastern Basin
Jordan River
Al Bireh
Ramallah
Jericho
Jerusalem
Bethlehem
Hebron
Dead Sea
Legend
Eastern Basin
North-Eastern Basin
Western Basin
Palestinian wells.
Municipal Wells
Israeli Wells.
Mekoroth wells.
WBWD Wells
Palestinian & Israeli Domestic Wells in the West Bank

Future perspectives

- Increase demands for fresh water
- Less fresh water will be available for agriculture
- Only high cash crops could afford expensive water prices
- More production of treated wastewater
- TWW reuse is a valid option for agricultural water

Status of wastewater systems

- Population in about 500 villages, towns and cities in the WB.
- Only 16 towns and cities with collection systems
- Only one treatment plant is running and effectively treating wastewater.
- Many on going studies and projects for collection and treatment of wastewater.

TWW Reuse

- Currently minor reuse activities at Al-Bireh WWTP within a greenhouse.
- Most of that water dumped in an open valley due to the location of the plant.
- Untreated WW which get mixed with fresh water from springs is being used in agriculture in the northern WB
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Palestinian Standards and Regulations for TWW Reuse

- Palestine Standards Institute:
  - PSI 742-2003
  - PSI 34-2012

- Ministry of agriculture:
  - Requires from farmers a reuse permit
  - Issues reuse permits
  - Reuse to be in accordance with PSI
  - Requirements on the farm level

Typical Quality of Raw Wastewater

BOD_5	500- 600 mg/l
COD	900- 1000 mg/l
TN	150-200 mg/l
TP	200-220 mg/l
TDS	1500 – 2000 mg/l
pH	7.3 to 8.1

Classification of Treated Wastewater Quality

Grade	Quality	Description
Grade A	High quality	BOD5 20 mg/l at most, TSS 30 mg/l, NO3-N 20 mg/l, at most and Feacal coliforms at most 200 per 100 ml
Grade B	Good quality	BOD5 20 mg/l at most, TSS 30 mg/l, NO3-N 20 mg/l, at most and Feacal coliforms at most 1000 per 100 ml
Grade C	Average quality	BOD5 40 mg/l at most, TSS 50 mg/l, NO3-N 30 mg/l, at most and Feacal coliforms at most 1000 per 100 ml
Grade D	Low quality	BOD5 60 mg/l at most, TSS 90 mg/l, NO3-N 40 mg/l, at most and Feacal coliforms at most 1000 per 100 ml.

Number of Barriers for Crops Irrigated with TWW

Crop/use	Low quality (D)	Medium quality (C)	Good quality (B)	High quality (A)
Gardens, sports fields, parks	Not allowed	Not allowed	Not allowed	0
Groundwater recharge by infiltration, discharge into seas at least 500 m in sea, Green fodders.	Not allowed	0	0	0
Crops for seeds, Dry fodders, Forests not used as parks, industrial crops and grains	0	0	0	0
Corn	4	2	2	0
Citrus irrigated without drip	4	3	3	0
Citrus irrigated by drip irrigation, Nuts (almonds, walnuts, pistachios, pine nuts), Stone fruits (peaches, cherries, apricots), Apples, tropical fruits (mangos, coco), Grapes, Cactus, Palms, Olives, Ornamentals,	3	2	2	0
Vegetables	Not allowed	Not allowed	Not allowed	Not allowed

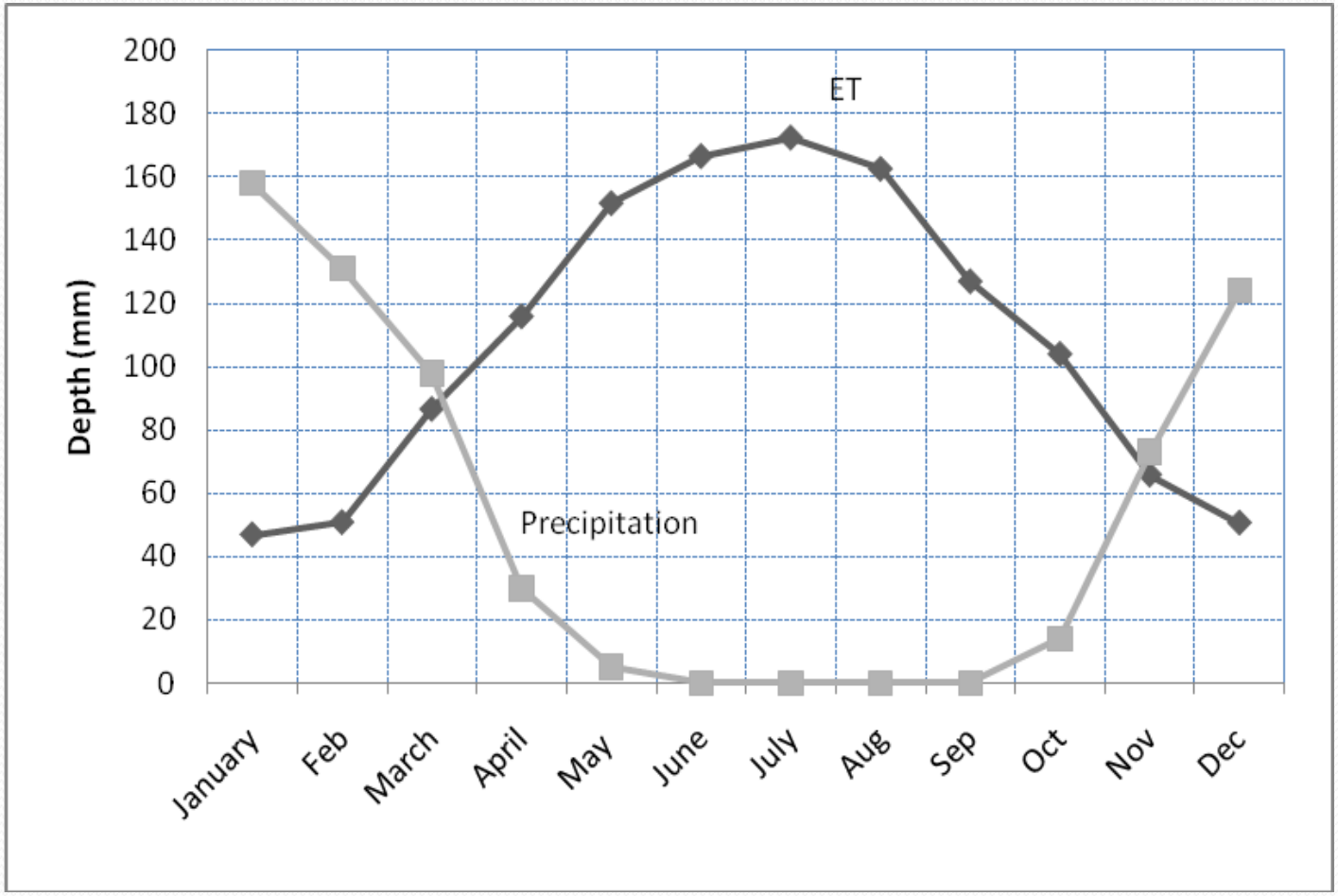
Potential crops for reuse

- Fodder crops
- Tropical fruits
- Stone fruits
- Grapes and nuts

Potential amounts and areas for reuse

- Potential volumes:
  - Domestic use 96 mcm/a now to 200 mcm/a in 30 years
  - TWW volumes 100-150 mcm/a in 30 years
  - Nearly double the existing amount of water currently used in agriculture
  - Reuse could double the irrigated area

Operational problems- supply vs demand



Farmers acceptance to reuse

Characteristics of farmers and farms

- Average cultivated area 14 dunums/ family
- Family size: 6- 8
- 3 agricultural workers per family
- 45% of interviewed farmers have education beyond high school

Characteristics of farmers and farms

- 83% own the land they cultivate
- Income from agriculture is less than 50% of total for more than 75% of those interviewed
- No prior knowledge of TWW reuse
- More than 77% never heard of reuse standards
- 80-90% believed TWW is technically possible and willing to do it

Farmers concerns about reuse

- Safety of reuse activities
- Marketing Risks
- Willing to reuse crops produced by TWW reuse
- Willing to pay 0.15 to 0.25 $/CM for TWW compared to 0.5 $/CM for fresh water
- Significant impacts of public awareness

Preferences of crops

- 70% preferred fruit trees
- Supplementary irrigation of olives
- 20% fodders
- Apparently more education is needed on the economy of different crops and options
- Need to look more into the standards

Conclusions

- Need to address farmers concerns in adopting standards and regulation- participotry approach.
- Relax standards at initial stages
- Involvement of community in planning for TWW projects, locations of plants of high concerns
- Need to address master planning and zoning areas in towns and cities

Conclusions and recommendations

- Addressing initial extra costs at farm level when TWW is utilized
- Include storage and irrigation infrastructure in the design
- Public awareness and public involvement at all stages of projects.