

Benchmarking Farmers' Economic and Social Status in Anantapuramu and Kurnool Arid Districts of Andhra Pradesh for Probable Introduction of Potato Crop

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Abstract

India has experienced rapid growth in potato production during recent past and the country has almost doubled its potato production during 2003-2013. The potato productivity improved 31.4% over this period of time. However, potato production scenario in southern states of India is quite grim and with the result potato consumers of these states always have to purchase potatoes at very high prices compared to the national average prices. With the objective to augment potato production in southern states this study was carried out for analysing socio-economic characteristics of potential potato growers in non-traditional Anantapuramu and Kurnool districts of arid region in Andhra Pradesh. A long list of socio-economic factors *viz.* education level, occupation pattern, house condition, tractor ownership, food security level, access and affordability to civic amenities, children's education type, possession of household amenities, expenditure pattern and level of mechanization adoption were studied in this study so that most suitable area for potato introduction may be identified.

Keywords: Anantapuramu, arid zone, Kurnool, poverty, socio-economic characteristics

India, the second largest producer of potato in the world almost doubled its potato production during 2003-2013 adding additional 22.18 million tonnes and taking total production to 45.34 million tonnes (FAOSTAT). During this period of time the country increased its potato productivity by 31.4% (augmentation of 5.44 tonne/ha) (Rana, 2015). This rapid growth in potato production figures in India were largely backed by the unnoticed food security role assumed by the potato (Thiele *et al.* 2010, Singh and Rana, 2013). The projected urban population of 840 million and total population of 1619

million people in India during 2050 along with other favourable socio-economic changes in the country support national target of producing 125 million tonne of potatoes during 2050 at an average productivity of 34.51 tonne/ ha (Singh *et al.* 2014).

However, picture of potato production in India is not all rosy and bright as this production is largely regional and seasonal. Nearly three fourth of potatoes in India are produced in three major producing states of Uttar Pradesh, West Bengal and Bihar in northern plains (based on NHB, 2015). But the potato production

scenario in southern states is very dismal and depressing. Against national average of 34.2 kg/capita/year potato production, the South Indian states produce just 2.2 kg/capita/year (Rana *et al.* 2015). All southern states produce just 1.95% of national potato output (based on NHB, 2015). The ratio of potato prices in southern and northern Indian states ranges from 1.5 to 3.0 (Rana, 2015). Since, per capita fresh consumption of potatoes in India is estimated to be 48.47 kg/ year during 2050 against the 19.78 kg/capita/ year during 2010 (Singh *et al.* 2014) and this demand is likely to increase proportionately in Southern India states too, these states are betting high on strengthening their own or local potato production in big way (Rana *et al.* 2015). Government of Andhra Pradesh is quite particular about it and the positive results, though on very small scale, are visible in Table 1.

Considering the significance and aptness of the problem and research preparedness (Minhas and Kumar, 2005; Schafleitner *et al.* 2007; Hassanpanah, 2010; Rana *et al.* 2011; Sharma *et al.* 2011; Kadian *et al.* 2012; Monneveux *et al.* 2013; Rana *et al.* 2013; Monneveux *et al.* 2014; Sharma *et al.* 2014) International Potato Centre, SWCA, New Delhi and ICAR-Central Potato Research Institute, Shimla carried out a collaborative study of assessing feasibility of introducing potato in non-traditional (Minhas *et al.* 2011) Anantapuramu and Kurnool districts of Andhra Pradesh. Since socio-economic analysis of respondents is very important in assessing their decision making pattern and capabilities (Rana *et al.* 2014), the current article targets socio-economic analysis of potential potato growers in these districts as a subset of the overall feasibility study.

Methodology

Current study is based both on secondary as well as primary sources of data. The secondary sources of data were Directorate of Economics and Statistics, Ministry of Agriculture and National Horticulture Database, Government of India. For primary information a survey was carried out in the August 2014 for obtaining statistics on demographic and socio-economic indicators of the responding family. The survey was conducted in two arid districts of Andhra Pradesh *viz.* Anantapuramu and Kurnool. Forty respondent farmers were selected from three villages of Anantapuramu district *viz.* Kurlapalli, Mallapuram and Chintralapalli. Similarly twenty seven respondent farmers were selected from two villages of Kurnool district *viz.* Bonthiralla and Yerragunthla. Guidance of ICRISAT, Patancheru, and Agricultural and Horticultural Research Stations of Anantapuramu was considered for making final selection of the villages. Respondents were selected using simple random sampling. A specially designed questionnaire for the study was used to record responses of sampled households in a personal interview. Education level, occupation pattern, house condition, tractor ownership, food security level, access and affordability to civic amenities, children's education type, possession of household amenities, expenditure pattern and level of mechanization adoption by the respondents were the points of key focus during this survey. In order to assess independence of mean responses from two different districts, t test for comparison of 'two population means' was employed.

Table 1: Potato production status in major producing states of India

Sl. No.	State	Area ('000 ha)			Production ('000 tonne)			Yield (tonne/ha)		
		00-01 ^s	07-08 ^s	13-14 ^s	00-01 ^s	07-08 ^s	13-14 ^s	00-01 ^s	07-08 ^s	13-14 ^s
1	UP	425.4	473.1	578.6	9466.6	13716.3	14121.4	22.3	29.0	24.4
2	WB	311.3	387.7	391.9	7281.7	10654.8	10104.5	23.4	27.5	25.8
3	Bihar	170.0	148.7	318.7	1605.4	1204.6	6426.1	09.4	08.1	20.2
4	Gujarat	31.9	53.3	78.5	735.6	1405.3	2387.6	23.1	26.4	30.4
5	Punjab	71.3	76.3	85.6	1424.6	2103.0	2141.8	20.0	27.6	25.0
6	Sub Total (1-5)	1009.9	1139.1	1453.3	20513.9	29084.0	35181.4	20.3	25.5	24.2
7	Andhra Pradesh	1.73	3.33	5.7	12.17	43.33	113.0	7.0	13.0	19.8
8	All India	1290.6	1478.9	1912.1	23488.9	37916.3	42964.9	18.2	25.6	22.5

§: Triennium ending average of the year

Source: Directorate of Economics and Statistics; National horticulture database, Government of India

Results and Discussion

Potato production scenario

Andhra Pradesh has shown tremendous growth in potato area, production and productivity during the past one and half decade (Table 1). However, this rapid growth is on very small base and still a lot needs to be done before the real impact of the potato development in the state is ensured. Incidentally, positive growth in potato area, production and productivity is visible in other states and at country level as well.

Social features of head of family

Age of the head of the household plays an important role in ability and rationality of decisions. On one hand young aged head are likely to make impractical decisions and old aged heads are likely to suffer from inability to make quick decisions. The overall age of head of the sampled households in the study area was 43 years without a statistical significance between the two districts (Table 2). Age of the family head indicates right environment for taking optimal farm decisions in the study area. Level of education of the respondent households' head was quite low which indicates their limitation to have sufficient access to latest knowledge in the field of their concern. Inadequate level of formal education is likely to be one of the reasons for poor transfer of technology (Rana *et al.* 2015) in the study area. Average schooling of the family's head in Anantapuramu (5.9 years) was statistically higher than that of Kurnool (4.5 years) district. Better farm profitability indicators of Anantapuramu vis-à-vis Kurnool (Rana *et al.* 2015) confirm the indications. Despite being small holders about 91% of the respondents were primarily employed in agriculture indicating lesser development of the study area and lack of non-farm employment opportunities.

Socio-economic well-being indicators

Different indicators of socio-economic wellbeing were studied in order to assess poverty/ prosperity of the respondent farmers (Table 3). These indicators have been pointwise described in the following text:

House condition: House condition is the strongest indicator of socio-economic wellbeing of a family. Average worth of the households of the responding families being less than ₹ 1 lakh doesn't indicate any prosperity of farmers in the study area. On the contrary it is a strong indicator of deep poverty or deprivation.

Tractor ownership: Ownership of a tractor indicates relative prosperity of a farm household. In the study area no respondent possessed a tractor in Kurnool district while only 9.9% respondents possessed a tractor. An interrogation into the matter clarified that in the study area tractor services are provided by non-farmers having tractors and using them for various purposes including transportation of materials even from mines. Hence, findings on this indicator are likely to be inconclusive.

Food security: The definition of food security in this study was very simple and primitive *i.e.* whether a family is able eat all full meals irrespective of nutritional part. Thanks to public distribution system and rural development schemes, all members of responding families were able to eat all full meals.

Individual water connection: This socio-economic indicator reflects overall rural development in the area and on this front there were deficiencies. Ideally every rural household should have its individual water connection however, only 32.5% of the responding households in Anantapuramu district had individual water connections against still meagre 21.7% in Kurnool. Higher proportion of individual water connections in Anantapuramu indicates better rural development level compared to Kurnool.

Table 2: Average age, education level and occupation of head of family in Anantapuramu and Kurnool districts of Andhra Pradesh

Particular(s)		Anantapuramu	Kurnool	Overall
Age (years)		43.33	42.53	42.93
Education level# \$\$		5.89	4.46	5.18
Primary Occupation (%)	Agriculture	90.11	92.31	91.21
	Others*	9.89	7.69	8.79

#: No. of schooling years \$\$: Application of t test indicated that the mean responses from two districts were statistically independent at 5% level of significance

*: Others include shop keeping, teaching and individual business *etc.*

Table 3: Socio-economic wellbeing indicators of respondent households in Anantapuramu and Kurnool districts of AP

Particular(s)	Anantapuramu	Kurnool	Overall
House condition (1-5)#	3.02	2.81	2.92
Tractors ownership (%)	9.89	0.00	4.94
Food security (%)	100.00	100.00	100.00
Individual water connection (%)\$\$	32.41	21.70	27.06
Water purifier (%)	7.32	0.00	3.66
Electrification (%)	100.00	100.00	100.00
Sanitation (%)			
Open field\$\$	65.02	89.01	77.02
Toilet\$\$\$	34.98	10.99	22.99
Children's school type (%)			
Government\$	73.90	81.45	77.68
Private\$\$	26.10	18.55	22.33
Social participation (%)@	67.76	59.34	63.55
Cooking gas (%)\$	59.89	70.88	65.39
TV (%)\$	84.80	70.88	77.84
DTH (%)	64.47	59.34	61.91
Mobile (%)\$	95.06	81.05	88.06
Home internet (%)	7.51	3.85	5.68
Email users (%)	4.94	3.85	4.40

#: Worth of house (1: < ₹ 40000; 2: ₹ 40000 to < 1 lakh; 3: ₹ 1 to < 5 lakh; 4: ₹ 5 to < 10 lakh; and 5: ≥ ₹ 10 lakh)

\$. \$\$ and \$\$\$: Based on t test, the mean responses between two districts were statistically different at 10, 5 and 1% level of significance, respectively

@: Social participation by any member of house *i.e.* in self-help group, Panchayat and cooperative society *etc.*

Water purifier: Having a water purifier, though not very common in Indian rural areas, is an indicator of economic wellbeing of a family. While none of the responding families in Kurnool possessed a water purifier only 7.3% possessed it in Anantapuramu.

Electrification: Electricity is the basic need of a family at this point of time hence lack of electrification of household is a strong indicator of backwardness of an area. However, all respondent households in both the districts had electrified households.

Sanitation: Incidentally the survey was conducted just few weeks before the Prime Minister of India launched "Swachh Bharat Abhiyaan (Clean India Mission)" on 2 October 2014 stressing highest focus on building adequate toilets to eradicate open defecation by 2 October 2019. There was emphasis on eradicating open defecation, although of lower magnitude, even prior to launch of this high profile and mega program. The study indicates really grim situation of open defecation

in the study area as 89% respondent families in Kurnool district were not having toilets in their houses. However, this proportion was statistically much lower at 65% in Anantapuramu, even then the situation was quite bleak in this district too.

Children's school type: School type of children is another indicator of economic wellbeing and access of the household to modern amenities. Respondents from Anantapuramu showed better level of economic wellbeing even on this indicator as higher proportion (26%) of children from these families were taking studying in private schools compared to Kurnool (18.5%).

Social participation: Social participation of family member(s) ensures better access to the latest knowledge on the subject(s) of farm business and taking right and timely decisions. Farming families of Anantapuramu district scored better even on this count as their social participation score was significantly

higher at 67.8% compared to 59.3% in Kurnool indicating higher propensity of the former district to better respond to agricultural extension initiatives.

Cooking gas: Possession of cooking gas in the kitchen of a rural household indicates better socio-economic status in an Indian village. Surprisingly on this count, Kurnool scored significantly better (70.9% respondents) compared to Anantapuramu (59.9%). Nearness of Kurnool sampled villages to the main road compared to the villages in Anantapuramu was one of the principal reason for this development.

Television: In present day world television has highest influence in every aspect of our life. This is one of the most potent source of information dissemination including the agricultural knowledge. Significantly higher proportion of farm families possessing television in their homes in Anantapuramu (84.8%) compared to 70.9% in Kurnool further confirm better chances of success of agricultural extension agencies in the former district.

Direct to home TV connection: Cable connected TV content providers are generally absent in rural areas due to low population density, hence viewers either have to be contented with the free to air antenna based few TV channels viewing or they have to opt for direct to home (DTH) TV connection. In the study area about 62% respondents had DTH connections in their houses, though most of them were based on one time installation charges (DD Direct). It indicates that entertainment is quite high on the agenda of the rural people.

Mobile phone connection: Mobile phones have been the strongest mode of communication these days. Most of the telemarketing and agricultural extension agencies are these days opting mobile phone network

as the most preferred mode. The farm households having at least one mobile connection in the family were statistically higher in proportion in Anantapuramu (95%) compared to Kurnool (81%) indicating better prospects of the farmers in former district as far as getting stimulated to new knowledge or change is concerned.

Home internet: Internet being another important mode of communication and perhaps the most important source of general information, its home availability was assessed. Overall a meagre (5.7%) proportion of farm households in the study area possessed internet facilities at their houses, hence rural development agencies should not expect farmers to learn from internet for the time being.

Email users: Email being the fastest and cheapest mode of written communication in the present day world, was also studied for its use, at home or out of home, by any member of the farm household in the study area. The findings were quite dismal at 4.4% in the study area indicating that this mode of communication is yet not the right choice for dissemination of information in the study area.

Expenditure pattern

In Indian context any enquiry on income of the household is a sensitive question and may lead to uncomfortable situation or even failure of interview process, hence, expenditure was taken proxy for household income and pertinent investigations were made. Expenditure pattern was studied under four broad heads viz. food, children's education, travel cost and cost of periodic bills (Table 4).

Food expenditure: Food expenditure is the most unavoidable or essential expenditure of any household.

Table 4: Average monthly expenditure pattern of sampled households in Anantapuramu and Kurnool districts of AP (₹)

Particular(s)	Anantapuramu		Kurnool		Overall	
	Expenditure	%age	Expenditure	%age	Expenditure	%age
Food \$	5104	56.39	4037	60.35	4570	58.07
Children education \$\$\$	1431	15.81	860	12.86	1146	14.56
Travel @	1349	14.91	1141	17.06	1245	15.82
Periodic bills #\$\$	1167	12.90	651	9.73	909	11.55
Total expenses \$\$	9050	100.00	6689	100.00	7870	100.00

@: Monthly expenses include petrol, diesel and bus tickets etc. it excludes expense on family holiday trips and other tours of casual nature

#: Periodic bills include expenses on electricity, water, newspapers, telephone, LPG refills/ charges and medical bills etc.

\$, \$\$ and \$\$\$: Based on t test, the mean responses between two districts were statistically different at 10, 5 and 1% level of significance, respectively

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However, higher proportion of expenditure on food is an indicator of poverty. In the study area about 58% of the total expenditure was made on food which indicates lower level of prosperity in the area. The absolute expenditure on food was significantly higher in Anantapuramu compared to Kurnool.

Children's education expenditure: This expenditure was about 66% higher in Anantapuramu compared to Kurnool district indicating access as well as willingness of Anantapuramu farmers to opt expensive education for their children.

Travel expenses: Traveling is another important reason of household expenditure for people including the sampled farmers. In study area farmers spent about 15.8% of their total average expenditure on travelling including fuel charges for personal transport and actual charges for public transport by all family members.

Periodic bills: Periodic expenses on electricity, water, newspapers, LPG refills/ charges, medical expenses and other miscellaneous activities constituted this head. Since, most of the periodic expenses are linked to level of development and earning these expenses in Anantapuramu were nearly 79% higher than Kurnool. Overall 11.55% of total monthly expenditure was incurred on such bill in the study area.

Total expenses: On an average ₹ 7870 were spent every month by the responding households. However, farmers in Anantapuramu district spent 35% higher money every month for their family needs compared to their counterparts in Kurnool.

Level of mechanization

Level of mechanization is an indicator of preparedness and propensity to adopt profitable and management intensive crops like potato. Mechanization level for different field operations like field preparation, planting, inter-culture operations and harvesting were studied and presented in Table 5.

Field preparation: This is the operation in the study area where use of farm machines is noticeable, even then, nearly 60% farmers in Kurnool and 15% in Anantapuramu still use bullocks for preparing their fields for sowing of seeds. The average mean level of mechanization in these two districts was different at one per cent level of significance.

Planting: For this farm operation overall higher use of bullocks was exercised. Noticeably significantly higher proportion (55.8%) of farmers used bullocks for planting operations in Anantapuramu district compared to 42.3% in Kurnool.

Inter-culture operations: No mechanization was adopted for performing inter-culture operations in the study area meaning thereby that these operations were done manually. Significantly higher proportion of farmers in Kurnool performed this operation manually (78.9%) compared to Anantapuramu (59.5%). Remaining proportion of this operation was carried out using bullocks.

Harvesting: Very high proportion of the crops were harvested manually in the entire study area, however, this proportion was much higher (83%) in Kurnool

Table 5: Level of mechanisation in Anantapuramu and Kurnool (% responses)

Particular(s)	Mechanism	Anantapuramu	Kurnool	Overall
Field preparation	Total \$\$\$	84.62	40.39	62.50
	Partial \$\$\$	15.38	59.62	37.50
Planting	No \$	44.23	57.69	50.96
	Partial \$	55.77	42.31	49.04
Inter-culture operations	No \$\$	59.48	78.85	69.83
	Partial \$	40.52	21.15	30.17
Harvesting	No \$\$	57.69	82.65	70.17
	Partial \$\$	42.31	17.35	29.83

Note: 1. Threshing of all major crops *i.e.* tomato, pulses, onion and chillies except groundnut is carried out manually

2. Fertilizers and chemicals are largely manually applied

3. No mechanization means the operation was done manually while partial means use of bullocks

\$, \$\$ and \$\$\$: Based on t test, the mean responses between two districts were statistically different at 10, 5 and 1% level of significance, respectively

compared to 60% in Anantapuramu. On the other hand bullock use in harvesting operation of field crops in Anantapuramu was significantly higher (42% respondents) compared to Kurnool (14% respondents).

Conclusion

This study was a component of big diagnostic study on feasibility of introducing potato in non-traditional Anantapuramu and Kurnool district of Andhra Pradesh. Socio-economic characteristics of potential potato growers in these two districts were analysed taking their suitability for potato cultivation into consideration. Most of these characteristics such as education level, socio-economic wellbeing indicators, financial strength and mechanization adoption level in Anantapuramu district were found better suited compared to Kurnool district. Hence, findings of this study support the other findings based on analysis of pre-requisites for introduction of potato in non-traditional arid zone of Andhra Pradesh (Rana *et al.* 2015) and the study recommends introduction of potato in the first phase only in Anantapuramu district of Andhra Pradesh.

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References

DES. 2013. State-wise potato area and production statistics. Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

FAOSTAT. 2015. <http://faostat3.fao.org/download/Q/QC/E>

Hassanpanah, D. 2010. Evaluation of potato advanced cultivars against water deficit stress under *in vitro* and *in vivo* conditions. *Biotechnology* **9**(2):164-169.

Kadian, M.S., Luthra, S.K., Patel, N.H., Bonierbale, M., Singh, S.V. and Sharma, N., Kumar, V., Gopal, J. and Singh, B.P. 2012. Identification of short cycle, heat tolerant potato (*Solanum tuberosum*) clones

for the semi-arid agro-ecology. *Indian Journal of Agricultural Sciences* **82**(9): 814-818.

- Minhas, J.S. and Kumar, D. 2005. Tuberization in Heat Tolerant Hybrid HT/92-621 under Controlled Temperature Conditions. *Potato Journal* **32**: 195-196.
- Minhas, J.S., Rawat, S., Govindakrishnan, P.M. and Kumar, D. 2011. Possibilities of enhancing potato production in non-traditional areas. *Potato Journal* **38**: 13-17.
- Monneveux, P., Ramírez, D.A. Pino, M.T. 2013. Drought tolerance in potato (*S. tuberosum* L.): can we learn from drought tolerance research in cereals? *Plant Science* **205-206**: 76-86.
- Monneveux, P., Ramírez, D.A., Awais, Khan, M., Raymundo, R.M., Loayza, H. and Quiroz, R. 2014. Drought and heat tolerance evaluation in potato (*Solanum tuberosum* L.) *Potato Research* **57**: 225-247.
- NHB. 2015. National Horticulture Database, <http://nhb.gov.in/>
- Rana, Rajesh K. Sharma, N. Kadian, M.S. Girish, B.H. Arya, S. Campilan, D. Pandey, S.K. Carli, C. Patel, N.H. and Singh, B.P. 2011. Perception of Gujarat farmers on heat-tolerant potato varieties. *Potato Journal* **38**:121-129.
- Rana, Rajesh K. Sharma, N. Arya, S. Singh, B.P. Kadian, M.S. Chaturvedi, R. and Pandey, S.K. 2013. Tackling moisture stress with drought-tolerant potato (*Solanum tuberosum*) varieties: perception of Karnataka farmers. *Indian Journal of Agricultural Sciences* **83**: 216-222.
- Rana, Rajesh K. Sharma, N. Arya, S. Kadian, M.S. Singh, B.P. and Pandey, S.K. 2014. Status of potato husbandry and farmers' socio-economic profile in moisture and heat prone Karnataka, India. *Pakistan Journal of Agricultural Sciences* **51**(1): 7-16.
- Rana, Rajesh K. 2015. Future Challenges and Opportunities in Indian Potato Marketing. Presented in, World Potato Congress-2015, 29 July 2015, Yanqing-Beijing, China: 21 slides.
- Rana, Rajesh K. Arya, S. Kumar, S. Singh, B.P. Adinarayana, G. Kumar, S. and Kadian, M.S. 2015. Analysis of Pre-requisites and Framework for Introducing Potato Crop in Non-traditional Anantapuramu District of Andhra Pradesh. *International Journal of Tropical Agriculture* **33**(2): 825-830.
- Schafleitner, R. Gutierrez, R. Espino, R. Gaudin, A. Perez, J. Martinez, M. Dominguez, A. Tincopa, L.

- Alvarado, C. Numberto, G. and Bonierbale, M. 2007. Field screening for variation of drought tolerance in *Solanum tuberosum* L. by agronomical, physiological and genetic analysis. *Potato Research* **50**(1): 71-85.
- Sharma, N. Kumar, P. Kadian, M.S. Pandey, S.K. Singh, S.V. and Luthra, S.K. 2011. Performance of potato (*Solanum tuberosum*) clones under water stress. *Indian Journal of Agricultural Sciences* **81**(9): 825-829.
- Sharma, N. Rawal, S. Kadian, M.S. Arya, S. Bonierbale, M. and Singh, B.P. 2014. Evaluation of advanced potato clones for drought tolerance in arid zone in Rajasthan, India. *Potato Journal* **41**(2): 189-193.
- Singh, B.P. and Rana, Rajesh K. 2013. Potato for food and nutritional security in India. *Indian Farming* **63**:37-43.
- Singh, B.P. Rana, Rajesh K. Govindakrishnan, P.M. 2014. Vision 2050. ICAR-Central Potato Research Institute, Shimla: 26 p.
- Thiele, G. Theisen, K. Bonierbale, M. and Walker, T. 2010. Targeting the poor and hungry with potato science. *Potato Journal* **37**(3-4): 75-86